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RAILWAY SHOPS.

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XI.

THE FOUNDRY.

Although but few of the present railway shop plants actually include an iron foundry, yet the importance of promptly securing castings is so obvious that the foundry becomes an important factor in the output results of any large shop; and, now that output is recognized as the criterion by which both the design and the operation of a plant are to be judged, it is probable that a greater proposition of railway shop foundries will be built in the future than have been in the past. Nearly every railway has its own brass foundry; while none, in this country at least, undert‹kes the manufacture of either malleable iron or steel cast‿gs. There are so few thoroughly modern foundries to be found in connection with railway shops that it will be necessary to include outside foundries in a consideration of the question.

Assuming that there is but one foundry on a system it should preferably be a component part of the principal shop, and the foundry building should be located as closely and conveniently as possible to both the machine shop and the storehouse—the machine shop as the point of greatest local consumption, and the storehouse as the shipping point for forwarding castings to outlying points; for it will be found that no other department of a shop ships away so great a quantity and weight of materials as the foundry does. The location of the foundry building having been determined by these considerations, the pattern shop and pattern storehouse should be kept in close proximity to it. At the new shops of the Locomotive and Machine Co., at Montreal, Canada, the foundry forms a wing to the machine shop—an unusual arrangement, but one making a very convenient working combination, and particularly justified by Canadian weather condtions.

The foundry floor plan does not necessarily conform to any very definite type, as practice furnishes examples of many different shapes and proportions, but the desire to use traveling cranes instead of depending entirely on swing cranes leads to the use of buildings with one or more main longitudinal bays, and with side bays for auxiliary purposes. Beyond this generalization it can be said that there is no such thing as a foundry plan for universal use, but that each plant should be adapted to its special conditions. The cupolas are always at one side of one of the crane-served bays, but not always at the middle of its length, as it saves time and steps to have the cupolas located near the light work, which is hand poured, leaving the heavy work to be reached by the crane ladle; this feature of cupola location is to be found, for instance, at Schenectady, N. Y. (General Electric Co.), Chicago Heights, Ill. (The Sargent Co.), and Reading, Pa. (Philadelphia & Reading Railroad).

In the side bays are found all such subsidiary features as light moulding, machine moulding, core ovens, flask-makers room, blower room, lavatories, cleaning and shipping facilities, and in a few instances, the brass foundry. The operation of cleaning castings, while in general done somewhere within the main building, is often provided for (especially in the treatment of light castings) by special rooms or wings. Sand storage is always provided for in modern foundries, generally in separate sheds, but, in a few cases, within the main building itself; one authority advocates providing for sand storage in the original design by brick walled sheds on the outside of the main walls of the building, the moderate amount of heat transmitted to the sand through the main wall serving to keep the sand in workable condition throughout the winter.

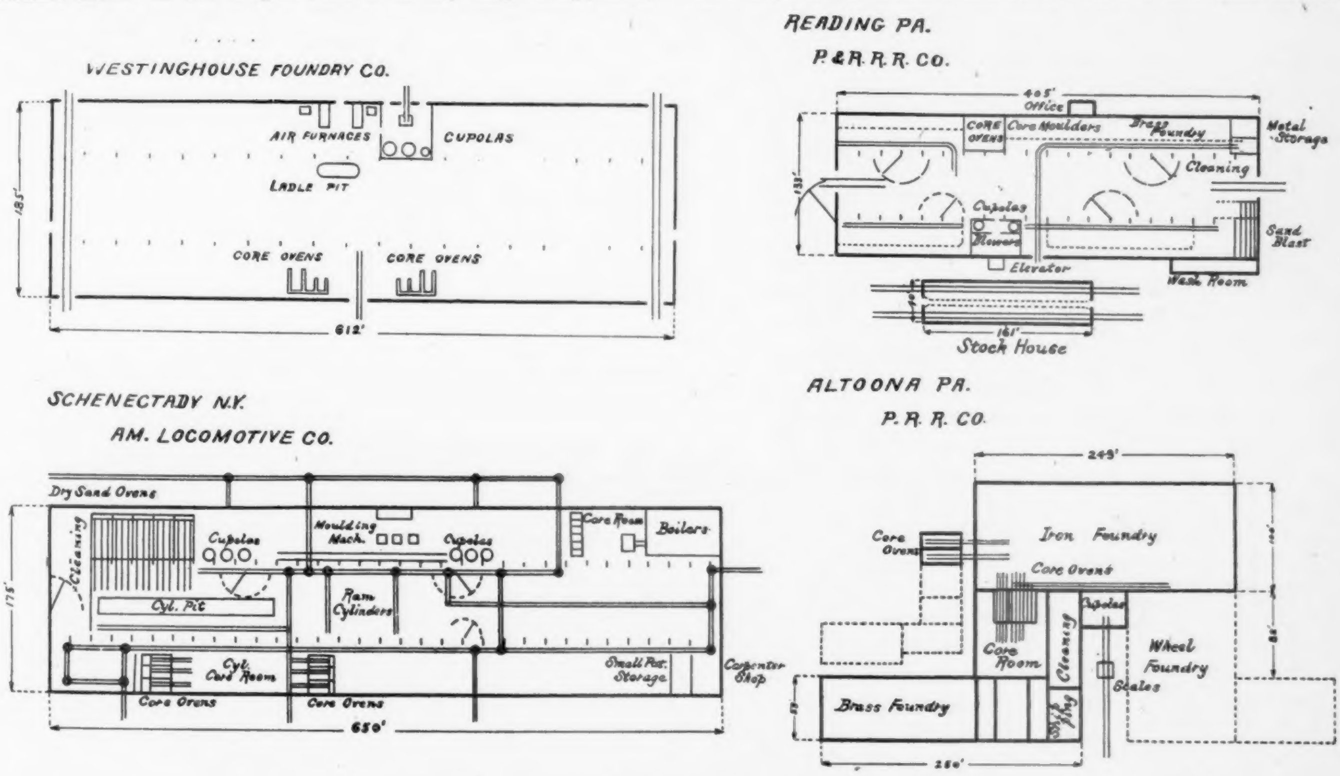


FIG. 6.—PLANS OF FOUR REPRESENTATIVE IRON FOUNDRIES.

The section of the three bay type of foundry is influenced by several factors, the principal one of which is the crane span of the central bay; the over all width, in five recent examples, is as follows: Trafford City, Pa. (Westinghouse), 184 ft.; Schenectady, N. Y. (American Locomotive Co.), 175 ft.; Burnham, Pa. (Standard Steel Works, owned by the Baldwin Locomotive Works), 158 ft.; Harrison, N. J. (Henry R. Worthington), 143 ft., and Reading, Pa. (Philadelphia & Reading Railroad), 130 ft. The height from floor to lower chord of roof trusses in the central bay would be influenced largely by the

size of the castings to be handled. In the case of the Reading Foundry—the only railroad foundry of the five—this height is 35 ft. The new foundry of the Montreal Locomotive & Machine Co. is of the two-bay type and the height is only 29 ft., but as an active foundry develops gas, smoke and steam, good light and ventilation are desirable, and a height of 35 ft. is preferable. The spacing of the columns (longitudinally) varies greatly; for instance, at Schenectary, N. Y. (General Electric Co.) it is 40 ft.; at Trafford City, Pa. (Westinghouse), 32 ft.; at Reading (Philadelphia & Reading Railroad), 20 ft.; and at Harrison, N. J. (Worthington's Light Casting Foundry), 12 ft. The wider spacing makes the use of the floor more flexible, and permits post cranes (whether fixed or portable) to sweep wider areas of central and side bays. The 12 ft. spacing at Harrison is a special case, as the light castings foundry floor was to be divided into transverse working strips 12 ft. wide, each having its own overhead crane; this required that the roof trusses should be placed on 12 ft. centers.

Traveling cranes are a feature of all the newer foundries, and their capacities will be found to range from 150 tons (Trafford City) down to 1 ton. The main crane at Reading is of 10 tons capacity, and at Montreal, 15 tons, which latter size is more likely to be taken as a precedent in railway practice. These traveling cranes are liberally provided; at Hamilton, O. (Niles Tool Works), there are 8, at Schenectady, N. Y. (General Electric Co.), 7; at Burnham, Pa. (Standard Steel Works), 5, and few good foundries have less than 3. Traveling or portable jib cranes are also a notable feature; in a few such cases the traveling is done by power, but in more cases by hand, while the hoisting is always electric. The portable jib crane is moved from column to column by the main traveling crane, and takes its hoisting current by means of plugs and local sockets; there are six such portable jib cranes in the foundry of the General Electric Co. at Schenectady, and four at Reading (P. & R.).

It will be found a great convenience to have two trolley hoists on the main crane, and this is getting to also be a feature of modern practice in foundries. An auxiliary light hoist will also be found to facilitate many floor operations. At Roanoke, Va., (N. & W.) a traveling crane has been introduced in the foundry, which had been built 20 years.

Standard gauge tracks are required for bringing in supplies and making shipments. Every foundry has at least one such track; the Trafford City foundry has four, one inside (transverse) at each end, and one outside (longitudinal) at each side; the Reading foundry has a similar equipment, except that the inside end tracks are longitudinal instead of transverse. Narrow gauge tracks (varying from 18 ins. to 30 ins.) are found in eleven foundries out of those under consideration; some use turntables and no curves, others use curves and no turntables, the majority use some of each, on the general plan of using turntables in the buildings and curves outside. At the new Hyde Park, Mass., foundry of the B. F. Sturtevant Co., nothing but turntables are used; there are 20 in the foundry, 14 in other buildings, and 30 in the yards, 64 in all. At Reading (P. & R.) it is evident that curves were considered preferable, as they are used both inside and outside wherever possible, the only two turntables to be found being located with restricted clearances where curves were not practicable.

Cupolas are of pretty well defined types, with numerous variations of the details such as the height and section of tuyeres, arrangement of spout, slag hole, drop bottom, etc. Cupolas of 72 ins. diameter are common in railway foundries, and will yield from 15 to 20 tons per hour each. Few railway foundries have more than two cupolas, while at Schenectady the American Locomotive Co. have six; at Trafford City there are three cupolas and two air furnaces, which can produce a combined melt of 114 tons, so that a 100 ton casting can readily be poured, and a 150 ton crane is provided, as previously stated. In the air furnace, the fuel is not mixed with the iron (as in a cupola), but it is fired separately, the heat being passed over the surface of the metal as in a reverberatory furnace. A much larger single melt may be obtained from an air furnace than from any cupola, and the quality of the casting is finer—two advantages which are of benefit in heavy electrical work.

The charging platform for use with cupolas should be about fifteen feet above general floor level, and should be served by a hydraulic lift of about 3,000 lbs. capacity; a few electric lifts have been installed for this service; but are not found to meet the peculiar conditions as well as the hydraulic lift. At Hyde Park (the Sturtevant Co.), there is a semi-automatic arrangement; a car which has been sent up loaded to the charging platform, is, after being emptied, pushed on to an inclined chute, runs down it some 125 ft. by gravity until stopped by a hydraulic buffer on an elevator platform, causes the elevator to descend by its own weight, and is then pushed off on the general floor level, the elevator returning automatically to its upper position, ready for the next car. At Reading there is a transfer table on the charging platform with several spur tracks leading from it, and on which several loaded cars can be kept, and in such a way that anyone of them can be taken out individually. The charging platform should also have a narrow gauge track scale for weighing each charge before it goes into the cupola.

The core ovens are generally found at one side of the building, but occasionally at one end. It will be found convenient to locate the larger ovens near to the loam and dry sand floors, and it will pay to have the small ovens close to the core makers' benches. The mason work of large ovens should be well and carefully done and all the proper flues, dampers, etc., provided so as to secure the desired uniform temperature and thorough drying effects; the firing for core ovens is usually done from the outside of the building.

At Schenectady (General Electric Company) are to be seen core oven carriages formed with shelves, and fitted with large rectangular end plates which form the door to the oven, thus confining the heat, whether the car is in or out; in this case the car is moved by a horizontal compressed air cylinder. At Hyde Park (the Sturtevant Company) there are six ovens; three are vertical cylinders, 7 ft. diameter, of the "reel" type, the other three being 4 x 9 ft., 5 x 9 ft., and 7 x 9 ft., and each having a car for heavy cores. At Schenectady (American Locomotive Company) there are 27 tracks leading into cylinder core ovens.

The work of cleaning the heavier castings is naturally done in one end of the main crane bay, but several modern foundries have separate cleaning departments—sometimes simply a space in a side bay, but not infrequently a special room equipped with facilities, such as tumbling barrels, emery wheels, sand blast, hydro-fluoric pickling baths, etc., where the medium sized and smaller castings are handled. Emery wheels and tumbling barrels are now often fitted with suction connections by which the dust is drawn away.

The shipping facilities of a railway foundry ought always to include a spur track (standard gauge) extending at least a car length into the main crane bay. At Altoona (P. R. R.) there is a very handy hydraulic platform lift adjacent to the shipping room, by which loaded handbarrows or trucks can be lifted from foundry floor level to car floor level, when a car is being loaded for shipment.

The storage of pig iron, coke, sand and general foundry supplies is being provided for in modern plants, whereas formerly the open space adjacent to the foundry was used without the provision of any special structures. At Hyde Park (the Sturtevant Company) all supply materials are kept inside the foundry walls, the bins being accessible from the adjacent outside track. At Reading (P. & R.), a special stock house is provided, with two tracks (on general ground level) on trestles rising up from a basement floor; the idea was that supplies could be dumped direct from hopper bottom cars into the bins below, whence they would be taken by narrow gauge track, through a tunnel, to an elevator, and thence either to the main floor, or the charging platform, as wanted. This stock house has been used just as intended for sand, coke, etc., but has been found inconvenient for pig iron, which is stacked in the open yard, nearby. At Harrison, N. J. (the Worthington foundry for light castings), the entire building has a basement, into

one end of which sand is unloaded (through trap doors) from a track entering one end of the building on ground level; similarly, when the molds are shaken out the sand from them falls through floor gratings into the basement, where it is mixed and tempered, and from whence it is again raised by special elevators to overhead hoppers, to be drawn by the molders, as needed.

Similarly, pattern storage is being better provided for than formerly, and fire proof or slow burning structures are found in several places. At Hyde Park and Harrison there are four-story buildings, and at Trafford City and Reading three-story buildings. At the new Readville, Mass., car shops of the N. Y., N. H. & H. there is an excellent one-story pattern storage building with solid side and end walls and with top light only.

Flasks may be a source of great expense and therefore afford an opportunity for economies; at Hyde Park (the Sturtevant Company) there is a flask shop, 60 x 80 ft., equipped with band saw, cross cut saw, split saw, boring machine, lathe, etc. Where a foundry has a great deal of standard, or repetition, work (as always in a railway foundry) floor space may be saved and the output increased by gradually substituting gray iron, or better, malleable iron flasks, for the wooden flasks. The economy of using snap flasks for producing large numbers of shallow molds is, of course, well understood.

Fig. 6 shows, on a uniform scale, the ground plans of the foundries at Trafford City, Schenectady, Reading and Altoona; the latter is old and well known, while the other three are new. This group of four plans shows the tendency to do things on a large scale in foundry practice. The location and general arrangement of the stock house at Reading may be noted. In this connection it should be stated that the Pennsylvania Railroad is about to abandon this old Altoona foundry in favor of a new and much larger one which is being erected at Burket, near Altoona.

Table 18 gives the output of six well known iron foundries, the unit adopted being the tons of castings produced per month per each 10,000 sq. ft. (100 ft. sq.) of ground area covered by the building, and including not only the floor space used for molding, but also that used for core making, cleaning, etc. The output of a foundry will vary with the character of the work done, and, in general, coreless castings of medium size and simple outlines will permit maximum output. The average unit output for the six foundries listed is 281 tons (per month per 10 000 sq. ft. of ground area), and it would seem that in designing new iron foundries to be used in connection with railway shops a unit output of 250 tons could safely be assumed.

The brass foundry admits of wide variation of design, from the simple one or two pot furnace plant up to the highly developed modern large plant, such as that of the Siemens and Halske Company (88 ft. x 327 ft.) at Berlin, as illustrated and described in a recent number of *The Foundry*.

There has been a tendency of late to adopt melting outfits larger than the old traditional crucible which could be lifted out of its furnace by one man working with tongs, and most modern plants which handle metal in large quantities use furnaces of the Schwartz or Paxon type, resembling the Bessemer converter on a small scale, using crude-oil, fuel-oil, or gas as fuel, and yielding a melt of from 250 to 4,000 lbs. per hour. In the brass department of the Hyde Park (Mass.) foundry of the B. F. Sturtevant Company, there is a special furnace of the reverberatory type, which is especially adapted to the melting of babbitt and other soft metals.

Another development of recent years has been the practice of locating brass foundries in the second story of steel frame buildings (where the first floor was needed for other purposes) as at the Baldwin Locomotive Works, Philadelphia, and the new shops of the Locomotive and Machine Company at Montreal. (*To be continued.*)

TABLE 18.

OUTPUT OF IRON FOUNDRIES.

Place.	Owner.	Kind of Castings produced.	Output in tons per month.	Estimated or Recorded.	Ground area in sq. ft.	Output in tons per month per 10,000 sq. ft. of ground area
Trafford City, Pa.	The Westinghouse Companies.	Heavy Machinery	2,575	Est.	113,220	227
Hyde Park, Mass.	The B. F. Sturtevant Co.	Light Machinery	1,300	Est.	53,560	243
Roanoke, Va.	The N. & W. R. R. Co.	Loco. and Car	593	Rec.	23,024	258
Burnham, Pa.	The Standard Steel Works.	Locomotive	2,166	Est.	78,000	277
Altoona, Pa.	The Pennsylvania R. R.	Loco. and Car	1,300	Rec.	41,154	316
Schenectady, N. Y.	The Am. Locomotive Co.	Locomotive	4,160	Est.	113,750	366
		Average Unit Output.				281

A METHOD FOR DETERMINING RATES AND PRICES FOR ELECTRIC POWER.

Under the above title, an interesting and important paper was read at the December (1903) meeting of the American Society of Mechanical Engineers by Mr. Frank B. Perry. The purpose of the paper was to point out the inequalities and injustices of the step system of rates which is ordinarily in use for charging for electric current supplied in large quantities. In this system, the contracts which the electric companies draw up with their customers frequently provide such a scale of rates that for a consumption between 1,800 and 2,160 kw. per month the current supply shall be charged for at a rate of $31.50 per kw. per annum, while between 2,160 and 2,520 kw. per month the rate shall be $31. This makes it possible, in extreme cases, for the consumer to secure a lower rate by consuming a single additional kilowatt, and in many cases in the author's experience substantial reductions could have been secured by consuming more power, which might obviously be done by the simple expedient of burning lamps in the daytime.

After explaining these irregularities of the usual method of basing rates, the author deduced a method which, while providing the same average prices per month, shall avoid these anomalies by doing away with the abrupt steps in the rates. Below a certain minimum and above a certain maximum consumption the rates are fixed, but between these points there is a gradual decrease in the rate which is read from a diagram, which diagram also gives the amount of each month's bill directly from the watt-meter reading.

A table was presented in which a comparison is made of the usual method of monthly charges for varying consumptions of power, and by the one proposed. While the averages are substantially the same, the charges for different amounts of power consumed are sometimes greater by one method and sometimes by the other; but the charges by the new method are consistent with one another, while those by the old method are not. This appears to be the only rational method of charging for varying amounts of current that has been devised, and is, consequently, of importance.

An apprentice course of instruction for draftsmen has been established by the General Electric Company at the Schenectady works. It is under the charge of Mr. J. W. Upp, and is intended to qualify applicants for work in the drafting rooms of the company.

COMPARATIVE TESTS OF BRAKE BEAMS.

STEEL VS. WOODEN BEAMS.

Tests were recently made by a prominent road of all of the makes of metal brake beams used on that road in freight service, and comparisons were drawn with a trussed wooden beam with respect to deflection and permanent set. The information thus obtained will doubtless lead to a test of all of the well known metal beams in order to ascertain whether any of the others will make a better showing against the wooden beams. These tests proved that the trussed wooden beam met the Master Car Builders' specification for deflection, while none of the four metal beams satisfied this requirement. It has been generally accepted as a fact that a trussed wooden beam would not stand the M. C. B. test. This is probably true of wooden beams tested in the past, and is due to the fact that the construction and design were defective. These tests prove conclusively that a wooden beam properly trussed will meet all requirements for freight service. There is no question of the fact that the wooden beam is superior to any of these steel beams, and they are all very well known makes. For obvious reasons the names are not given. It is not easy to use trussed wooden beams for inside hung brakes.

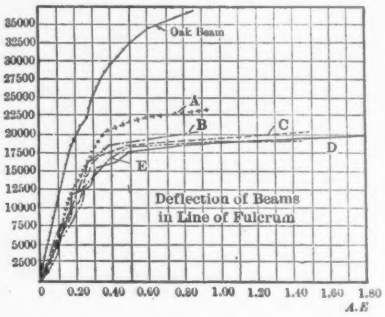


FIG. 1.

Probably an increase in weight will be necessary. Undoubtedly the effort in the direction of reducing the prices has led to a sacrifice of strength, and when the attention of the manufacturers is called to this comparison a great improvement will be made. The accompanying diagrams illustrate the comparison and indicate the great superiority of the wooden beam over the metal ones used. These metal beams are represented by the letters A B C D and E. They represent the construction of some of the leading brake beam manufacturers. This may not be exactly a pleasant surprise to the metal brake beam people, but it is well to know the facts in order that they may be acted upon.

One of the principle arguments which has been constantly used in demanding the advance of wages by railroad men is the increased cost of living, and this reason is still alleged as justifying further demands. Careful figures show that the average increase in cost of living in Chicago is 11.3 per cent. over that of five years ago, while the increase in wages has been greatly in excess of that amount, that of railway employees being from 15 to 18 per cent. According to the best, as well as most conservative opinion, wages, at least so far as railway employees are concerned, have reached their maximum, and any further demands in that direction will of necessity be refused. Unfortunately it is next to impossible to convince the lower classes of railway employees that large earnings do not necessarily mean large profits. They seem to have an idea, that because the receipts run up into the millions the profits are correspondingly large. That railroads have done extraordinarily well for the past few years is known, but that present indications presage anything but a continuance of this prosperity is also well understood. The more intelligent of the employees will find it to their advantage to check any attempts on the part of those not so well posted to exact higher wages, because if insisted upon such a course can only result in a stoppage of work.—*The Railway and Engineering Review.*

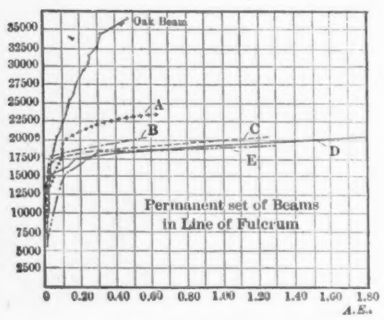


FIG. 2.

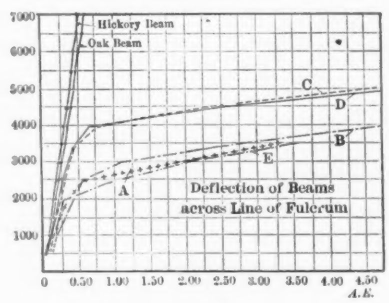


FIG. 3.

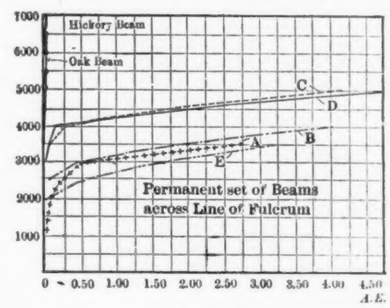


FIG. 4.

COMPARATIVE TESTS OF BRAKE BEAMS.

The surprising results of these tests will doubtless lead to a study of the problem and probably to an improvement in metal beams.

These tests show that the metal beams began to deflect with a relatively light load, and that they were not elastic. One of the facts brought out is the weakness across the fulcrums. The wooden beam stood far higher in all respects. As a result of this investigation there is at least some hesitation on the part of this road to adopt metal brake beams until they make a better showing against wooden ones. In the matter of cost there is little choice between wood and metal, and the officers of the road believe they will have no trouble to secure good oak and hickory in sufficient quantities.

The M. C. B. specifications require that "all beams must be capable of withstanding a load of 7,500 lbs. at the center without more than 1-16 in. deflection." There is no specification of the deflection across the fulcrum. In view of these results it seems advisable to specify that deflection also. It is difficult to state just what the deflection ought to be in this direction, but as many beams fail in that direction the matter should be settled.

These 5 metal beams vary in weight from 67 to 119 lbs.

The officers elected for the American Society of Mechanical Engineers for this year are as follows: President, Ambrose Swasey, Cleveland, Ohio; vice-presidents, Prof. D. S. Jacobus, Hoboken, N. J.; M. L. Holman, St. Louis, Mo.; W. J. Keep, Detroit, Mich.; managers, George I. Rockwood, Worcester, Mass.; J. W. Lieb, Jr., New York City; Asa M. Mattice, Pittsburgh, Pa.; treasurer, William H. Wiley, New York City, reelected. The next meeting will be held at Chicago.

We are informed that an oil-engine-propelled motor coach is to be tried by the Great Northern Railroad, in England. The car is to be of the standard gage, with a capacity for 30 passengers. The engine will be the Roots type of oil-engine, developing 40 horse-power, and four speeds will be provided forward and reverse by gear mechanism. There will be a cab at either end of the car for the accommodation of the motorman, or engineer, so that it may be propelled in either direction, with the engineer always at the front of the vehicle. The engine is to be available for various kinds of liquid fuel, such as ordinary petroleum oil, gasoline or kerosene. In the first car attention will be devoted more to reliability and efficiency in the motor than to speed. The highest speed will not be greater than 35 miles per hour.

EDITORIAL CORRESPONDENCE.

IMPRESSIONS OF FOREIGN RAILROAD PRACTICE.

(*Continued from Page* 51.)

The English railway carriages of the old, but most numerous type, with closed compartments, are veritable *chambers of horror*. How such an intelligent class of people can endure them is an impenetrable mystery. These vehicles are descended from the stage coach of our ancestors. The lineage is too direct. It is sometimes a good thing for new blood to come into a family to improve the stock. An occasional marriage of the leading daughter to the coachman does no harm. This carriage is simply ridiculous, barbarous, dangerous and absurd. English railroad men know better, as they have shown by building corridor cars, which are very comfortable. But the older type of carriages (without toilet arrangements) stands as a blot upon foreign railroad practice which is not confined to England. Rather usual absence of steam heat and other inconveniences may be forgiven but the practice of shutting people up in a closed cell with absolutely no opportunity for communication with the surrounding humanity is not to be admitted to have any place in modern facilities for traveling. Of course, one may, to a certain extent, select his traveling companions by searching every compartment of a train at a station and that is what is done. Seclusion seems to be the object of English travelers and it often leads to what we would call—"plain hog." A sixpence to the guard will tend to "seclude" a compartment to the knowing traveler, and you may look long and far for the guard to let you into one of these. On the other hand, the seclusion is not always what it appears to be. A lady traveling alone, need never be embarrassed, if she knows the ropes and fees a guard to put her into a compartment reserved for ladies, but there is positive danger in omitting this precaution. A sad case was brought to the writer's notice, in which it is to be hoped, for charity's sake, that the man concerned was an escaped lunatic. People sometimes pay dearly for this fad of exclusiveness and after all on a crowded train one is in closer contact with his neighbors than in our cars.

It is, on the other hand a pleasant surprise to find such comfortable cars in the specially good trains. The improvement of the last ten years has been very great, and it is to be hoped that further progress will be made. These criticisms apply to the older type of "carriages" without corridors and other improvements of the later part of the nineteenth and the present centuries. English railroads lay themselves open to criticism because they do not retire this old equipment at a more rapid rate. The situation requires heroic treatment.

Coal is hauled in boxes with two axles, the capacity being from 6 to 8 tons and the dead weight about the same as the load. There are notable exceptions, but many coal cars of this sort are now in service. The maximum total width of passenger cars is 9 ft. 3 ins., and I found no goods wagons wider than 8 ft. It is worthy of note that the capacities of the freight equipment which is being discarded at home, are larger than that in use here. Instead of increasing the capacities of cars and locomotives, the English roads have merely increased the number of trains, and this has led to increasing the number of tracks on which to handle the heaviest traffic. Perhaps this was the best thing they could do, because of the vast expense of increasing clearances, but it merely puts off the evil day because roads with small clearances cannot haul heavy trains. As business increases more tracks will need to be built, and probably the cost of this will be more than that of enlarging the clearances. But this question is a difficult one, which the writer is glad he is not called upon to decide.

Some of the roads are building larger coal cars. The Caledonian has some excellent large steel cars (see American Engineer October, 1899, page 320) and is taking up self-clearing cars. I am told that the Clearing House has taken official action to prevent the use of large hopper cars by the owners of private cars, though I cannot imagine a satisfactory reason for such a position.

There are good reasons to believe that the best relief of the transportation problem in England will be the use of electric traction. This will solve the locomotive difficulty and the cars may then be attended to at leisure. The traffic is dense and the only obstacle is the fact that the roads are likely to find it very difficult to provide the capital necessary for the change.

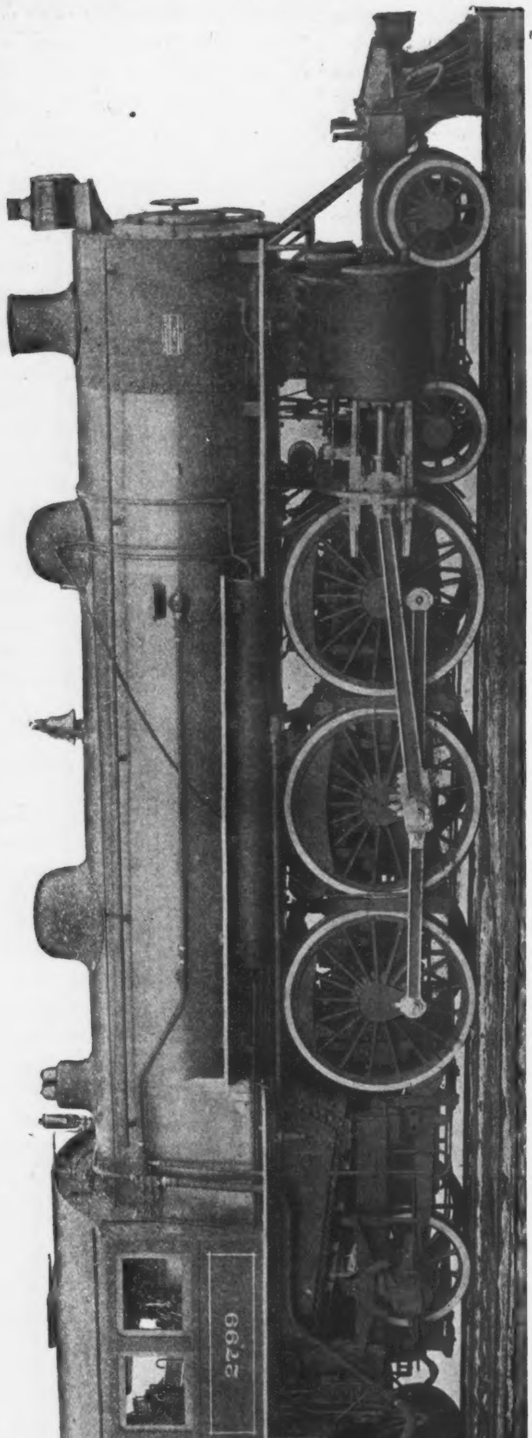
The sleeping cars of the east and west coast trains are very comfortable. A passenger has a small space all to himself, with separate toilet facilities and it is not necessary for him to go out of his compartment until fully dressed. The hot coffee brought in by the attendant begins the morning in good order and renders the traveler good natured all day. Ladies have something better than a curtain as a shelter. In several respects these sleeping cars are in advance of ours.

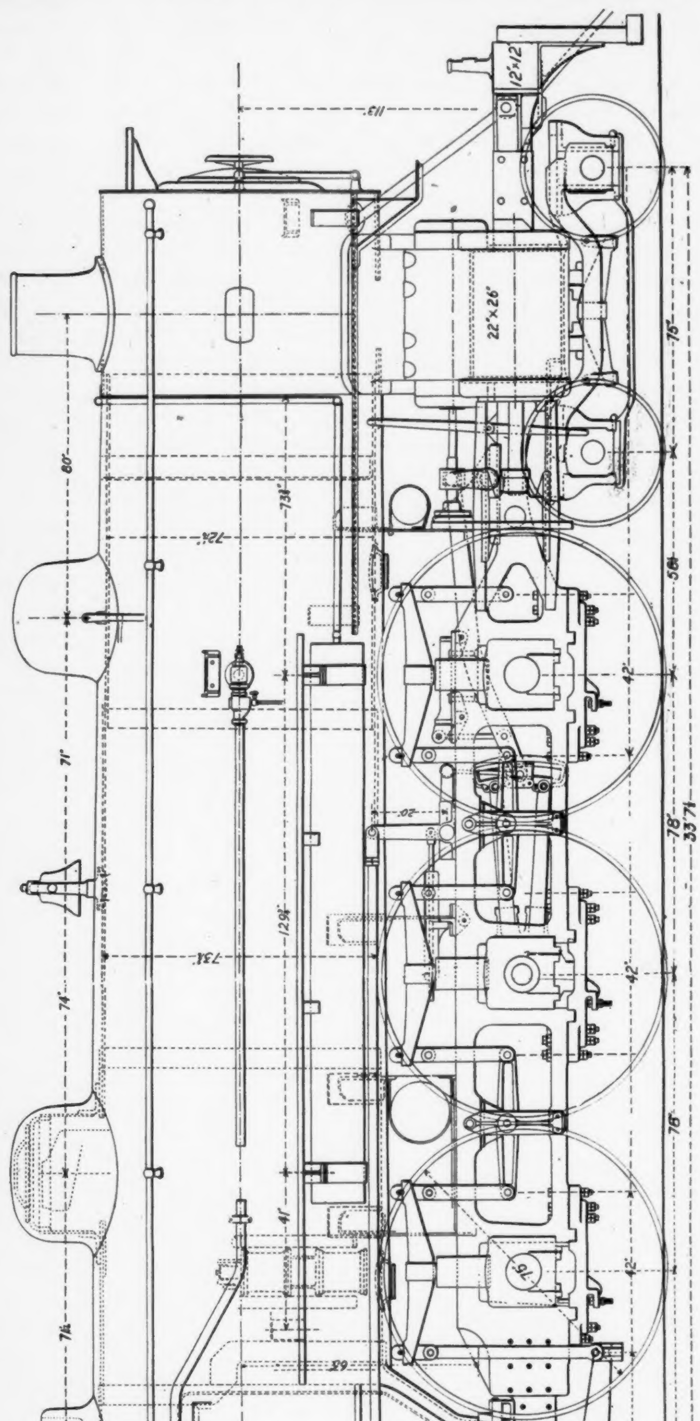
While American coaches are more comfortable than the English, they weigh far more per passenger. On the Caledonian Railway, for example, an ordinary first-class carriage with 7 compartments seating 56 people, weighs 22 tons or about 0.4 ton per passenger. An ordinary third-class carriage, 48 ft. in length, seats 80 passengers and weighs 21 tons—0.26 ton per passenger. English cars are of frail construction, compared with ours, and they lack platforms, but there is something very attractive in their light weight. They ride well and also run easily. It was interesting and amusing to see on the London & Northwestern, at Crewe, a so-called heavy baggage van placed on the main line for loading, by a horse. He was an able-bodied animal and gave the car a sudden short pull, after which he hustled along to keep out of its way, while it coasted perhaps 40 feet. Now what impression would a horse make on one of our modern baggage cars? This goes to show that these trains pull easily.

Premiums to locomotive engineers are the rule in England. Various methods for alloting them are followed on the different roads. On the London & Southwestern, Mr. Drummond very carefully figured the coal consumption of all important runs, taking an average for a number of years and after adding to this average about 15 per cent., he established an allowance for each. The enginemen are paid a cash premium of 20 per cent. of the value of the coal they save, that is to say, that proportion of the amount they use, deducted from the allowance. On this road cash prizes are paid also for meritorious service of any kind which leads to a saving of expense to the company. The discovery of a broken rail or anything of that kind is thus rewarded. Premiums are paid to the engineers on the Midland and are based upon all around service, considering the consumption of coal and engine supplies, punctuality and the general standing of the men in their efforts to save their employer's money and improve the service. This road pays out a large sum annually in this way. Punctuality is a very important factor in judging the premiums and for this reason the engineers do their utmost to have their engines kept up in good condition all of the time. They are supported and encouraged by the officials, to refuse to take out an engine which is in bad condition or not ready in every way for the best work. Other roads also pay cash premiums and it may be said to be a feature of English practice, which contributes toward getting excellent work out of locomotives.

"It is an unpardonable sin to have a train delayed by a locomotive failure." This remark was made in answer to a question which the writer has asked pretty generally all over Europe. It was made by the general manager of an English road. His standing in motive power matters is secured by over ten years as locomotive superintendent of the road and by the fact that he had the AMERICAN ENGINEER in bound volumes in his book case and the latest issue was open upon his desk, when the writer called. He has read this journal for many years and several years ago was invited to preside over the entire operation of the road. (Let the young reader at home take special note of this.) He said, "We cannot afford to have locomotive failures, for they would tie us up tight as a drum." This is a fact. Passenger service has become so exacting here as to compel great attention to the conditions of locomotives.

G. M. B.





SIX COUPLED PASSENGER LOCOMOTIVES 4-6-2 (PACIFIC) TYPE, NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

J. F. DEEMS, *General Superintendent Motive Power.* AMERICAN LOCOMOTIVE COMPANY (SCHENECTADY WORKS), *Builders.*

SIX COUPLED PASSENGER LOCOMOTIVES.

4-6-2 (PACIFIC) TYPE.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

Until now the heaviest passenger locomotives on this road were those of the 4-4-2 type illustrated in this journal February, 1901, page 35, which have given excellent service. We now illustrate one of two new designs, from which very heavy six-coupled engines have been built by the American Locomotive Company at Schenectady. The heavier and larger design is shown, and by referring to the description of the Chicago & Alton engine of the Baldwin Works (March, 1903, page 87) it will be seen that the new New York Central engine is a close second for the honor of being the largest and heaviest passenger locomotive in the world. It has a boiler 72 1-16 ins. in diameter at the smallest ring, which, with the exception of the 2-8-0 type engine of the Colorado Midland (February, 1902, page 49), is the largest boiler ever put on a passenger engine. As the Colorado Midland engine is for special mountain service, it is not exactly in the class of this new design, which indicates a tendency toward securing improved circulation by providing the maximum possible amount of room for water in the boiler. This boiler has 303, 2¼-in. tubes, with ¾-in. spaces. The total heating surface is 3757.7 sq. ft., which indicates the appreciation of the necessity for space for circulation. It is further indicated in the 4½-in. water spaces all around the firebox at the mud ring. With the six-coupled driving wheels and a wide firebox, long tubes are necessary. Their length in this case is 20 ft., the same as those of the Chicago & Alton engine already referred to.

These engines have inside admission, piston valves with direct valve motion, cast steel frames with slab (or plate) rear sections and no joints in the frames, except at the rear of the rear diving axles. They have a new design of radial trailer trucks with radius bars and outside journals, and among the detail parts cast steel is liberally used. The pedestal binders are of cast steel, of a modified form of the old strap type, having slots 2 ins. deep for projections extending that depth into the binders. This road has given up the bolt form of binder because on engines of recent design, they would be too large to be properly tightened up in the roundhouse.

It will be remembered that the 4-4-2 type locomotive of this road are equipped with trailing trucks having outside journals. The new engines, having a very long wheel base, required a radius bar truck and a new one was designed for them. It has a frame of triangular form turning about a radius 75 ins. long when measured from the center of the axle to the center of the bearing. The form of the truck is indicated in the engravings. It was the intention to show a detail drawing of this truck, but it is omitted from this description, because a change is contemplated, which will facilitate changing the trailer wheels. The outside journal construction was used because it provides room for a good ash pan.

The frames of these engines are secured to a front deck casting in front of the cylinder, they are braced laterally by another similar casting over the front driving axle and by a third heavy casting at the back ends of the frames. The engine has self-cleaning front ends, which have now become usual practice on this road.

These heavy engines are used on the Mohawk and the Western divisions. Other engines of the same type and generally similar dimensions, by the same builders, are giving excellent service on the Boston & Albany division. In the accompanying tables the chief dimensions of the latest design, (which is known as "Class K") ratios, and some comparative figures are given.

SIX-COUPLED PASSENGER LOCOMOTIVES, 4—6—2 TYPE.
NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

RATIOS.

Heating surface to cylinder volume	=	328.4
Tractive weight to heating surface	=	37.4
Tractive weight to tractive effort	=	4.92
Tractive effort to heating surface	=	7.58
Heating surface to grate area	=	74.8
Heating surface percentage of tractive effort	=	13.2
Total weight to heating surface	=	58.2

COMPARISON WITH OTHER LARGE PASSENGER LOCOMOTIVES.

Road.	Engine Number.	Total Weight.	Total Heating Surface	Total Weight divided by heating surface.
C. & A.	601	219,000	4,078	53.7
N. Y. C.	2,794	218,000	3,757	58.2
El Paso & So. Western	——	209,500	3,818	54.8
No. Pacific	284	202,000	3,462	58.3
A. T. & S. F.	1,000	190,000	3,738	50.1
C. & O.	147	187,000	3,533	52.9
L. S. & M. S.	650	174,500	3,343	52.2

GENERAL DIMENSIONS OF NEW YORK CENTRAL 4—6—2 TYPE.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous Coal
Weight in working order	218,000 lbs.
Weight on drivers	140,500 lbs.
Weight Engine and Tender in working order	340,400 lbs.
Wheel Base, Driving	13 ft. 0 ins.
Wheel Base, Rigid	13 ft. 0 ins.
Wheel Base, Total	33 ft. 7½ ins.
Wheel Base, Total, Engine and Tender	67 ft. 6¾ ins.

CYLINDERS.

Diameter of Cylinders	22 ins.
Stroke of Piston	26 ins.
Horizontal thickness of Piston	6½ ins.
Diameter of Piston Rod	3¾ ins.
Kind of Piston Rod Packing	U. S. Metallic

VALVES.

Kind of Slide Valves	Piston type
Greatest Travel of Slide Valves	6 ins.
Outside Lap of Slide Valves	1 in.
Inside Clear of Slide Valves	⅛ in.
Lead of Valves in full gear line and line full forward motion	¼ in. lead at ¼ stroke cut off.
Kind of Valve Stem Packing	U. S. Metallic

WHEELS, ETC.

No. of Driving Wheels	6
Diameter of Driving Wheels outside of Tire	75 ins.
Thickness of Tire	3½ ins.
Driving Box Material	Cast Steel
Diameter and Length of Driving Journals	9½ ins. diameter by 12
Diameter and Length of Main Crank Pin Journals (Main Side 7½ by 4¾)	7 ins. diameter by 6½
Diameter and Length of Side Rod Crank Pin Journals, F. & B.	5 in. diameter by 4¾
Engine Truck, journals	6¼ ins. diameter by 10 ins.
Diameter of Engine Truck Wheels	36 ins.
Kind of Engine Truck Wheels	Krupp No. 3 Cast Iron spoke center
Trailing Wheels, diameter	.50 ins.
Trailing Truck journals	8 by 14 ins.

BOILER.

Style	Straight top radial stayed
Outside diameter of first ring	72 1-16 ins.
Working Pressure	200 lbs.
Thickness of plates in barrel and outside of fire box,	½ in., 9-16 in., 23-32 in., ¾ in., and 1 in.
Fire Box length	96⅛ ins.
Fire Box, width	75¼ ins.
Fire Box, depth	Front 79½ ins., back 64¾ ins.
Fire Box plates, thickness,	Sides, ⅜ in., back, ⅜ in., crown, ⅜ in., tube sheet, ½ in.
Fire Box Water Space	Front, 4½ ins., sides, 4½ ins., back 4½ ins.
Fire Box, Stay Bolts	Taylor Iron 1 in. diameter
Tubes, number	303
Tubes, diameter	2¼ ins.
Tubes, length over tube sheets	20 ft. 0 in.
Fire Brick, Supported on	Water tubes
Heating surface, tubes	3,553.8 sq. ft.
Heating surface, water tubes	23.6 sq. ft.
Heating surface, fire box	180.3 sq. ft.
Heating surface, total	3,757.7 sq. ft.
Grate surface	50.23 sq. ft.
Exhaust Nozzles	5⅜ ins., 5⅝ ins. and 5⅞ ins. diameter
Smoke Stack, inside diameter	20 ins.
Smoke Stack, top above rail	14 ft. 6 ins.

TENDER.

Style	Water bottom
Weight, empty	52,400 lbs.
Wheels, number	8
Wheels, diameter	36 ins.
Journals, diameter and length	5½ ins. dia. by 10 ins.
Wheel Base	16 ft. 9½ ins.
Tender Trucks	Fox Pressed Steel
Water Capacity	6,000 U. S. gallons
Coal Capacity	10 tons
Brake	Westinghouse American combined

We take pleasure in announcing that we have turned over the management of our book department to the well known publishers, the Norman B. Henley Publishing Company, 132 Nassau street, New York, who will hereafter handle all book orders placed with us and answer any inquiries regarding prices or the choice of books on technical subjects or devoted to the trades. The Henley Publishing Company have published a large number of valuable books upon railroad, as well as other technical subjects, which they are prepared to supply promptly, and they are furthermore prepared to obtain any technical book, whether published in this country or abroad. Their varied and extensive experience in this line places them in position to be of great service to those in need of technical publications.

THE APPLICATION OF INDIVIDUAL MOTOR DRIVES TO OLD MACHINE TOOLS.

McKees Rocks Shops.—Pittsburgh & Lake Erie Railroad.

BY R. V. WRIGHT, MECHANICAL ENGINEER.

VIII.

TURRET LATHES.

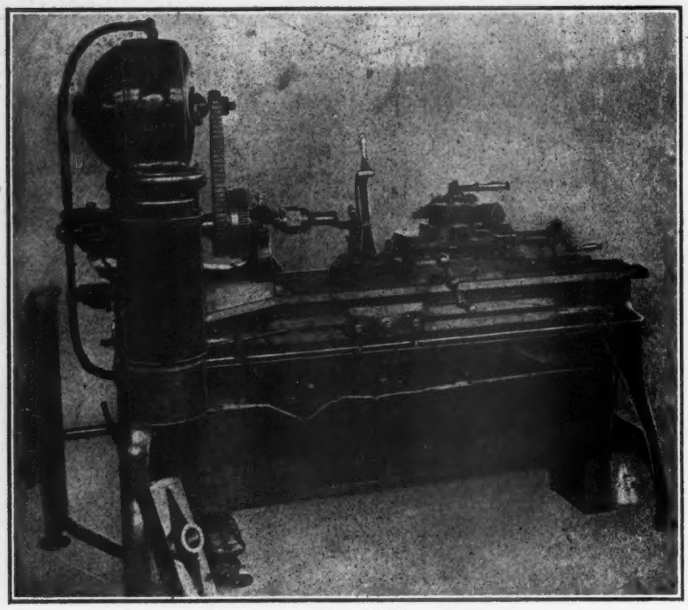


FIG. 37.—THE APPLICATION OF MULTIPLE-VOLTAGE INDIVIDUAL DRIVING TO THE OLD 18-INCH BRASS TURRET LATHE.—CROCKER-WHEELER SYSTEM.

Reference was made in considerable detail to the methods employed in equipping the various types of lathes for individual motor driving at the McKees Rocks shops, in the second, third and fourth articles of this series (pages 165, 219 and 410 of the preceding volume, 1903), but it has been impossible heretofore to discuss the details of the changes which were made upon the turret lathes. In this article the application of the individual motor driving to two of the old turret lathes, which were used at the old shops, will be described.

Figs. 37 and 38 illustrate the motor application to an old 18-in. turret lathe, which is used for brass work. Fig. 40 shows details of the cast iron bracket that was used to carry the motor above the head stock, as shown; while Fig. 39 presents a detail of the combination latch-plate and sleeve, which was the only other change required upon this machine.

As this lathe is used exclusively for turning brass, and, as ordinarily only small work is handled upon it, it was seen that the slow run of gears would seldom be used, and it was thus

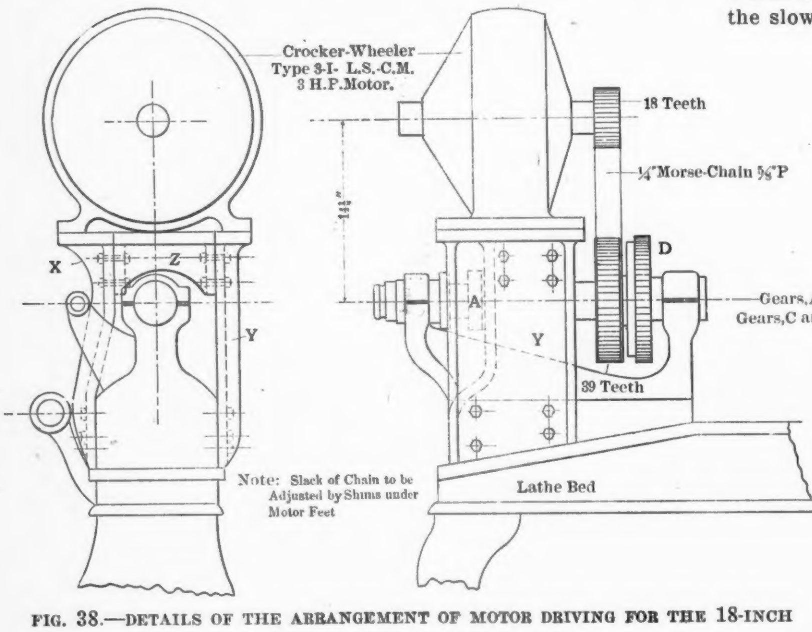


FIG. 38.—DETAILS OF THE ARRANGEMENT OF MOTOR DRIVING FOR THE 18-INCH TURRET LATHE FOR BRASS WORK.

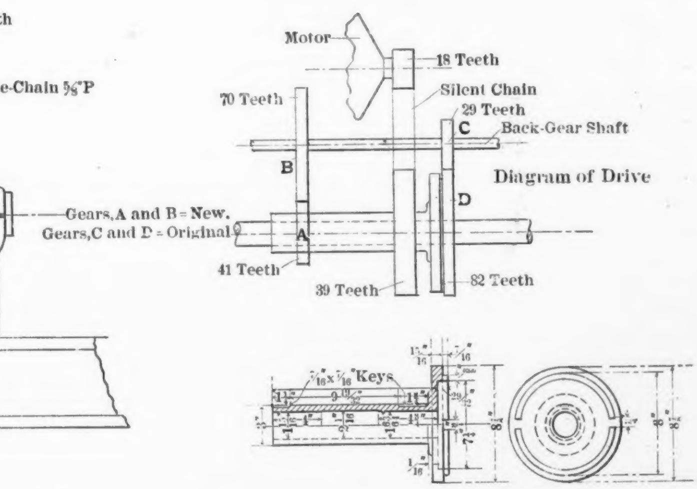


FIG. 39.—DIAGRAM OF THE NEW ARRANGEMENT OF DRIVE, AND DETAILS OF THE NEW SPECIAL SLEEVE.

decided to retain the original method of throwing the back gear in and out, in place of adding a more elaborate system of gear changes, using clutches. In order to adjust the back gear ratio to suit the speed range of the motor, only two new gears, A and B (see diagram of the drive, Fig. 38), had to be provided. Thus it was only necessary to replace the four-step belt cone by a combination latch plate and sleeve (shown in Fig. 39), upon which sleeve was keyed the new gear, A, and the large sprocket for the Morse silent-chain drive from the motor.

The motor, which is a Crocker-Wheeler type 3 I-L-S.-C.M multiple-voltage motor, developing 3 h.p. at 240 volts, is supported by the set of simple cast iron brackets, shown in Fig. 40. The controller is the type M.F.-21, Crocker-Wheeler multiple-voltage controller, and is attached to the bed of the lathe in front of the head stock, as shown in Fig. 37. With this arrangement, the operator can easily manipulate it with his left hand while watching the work.

The range of speeds thus available at the spindles and also the power available at each of the various speeds is indicated upon the diagram, Fig. 41. It will be noted that the minimum horse-power provided by the motor with this arrangement of

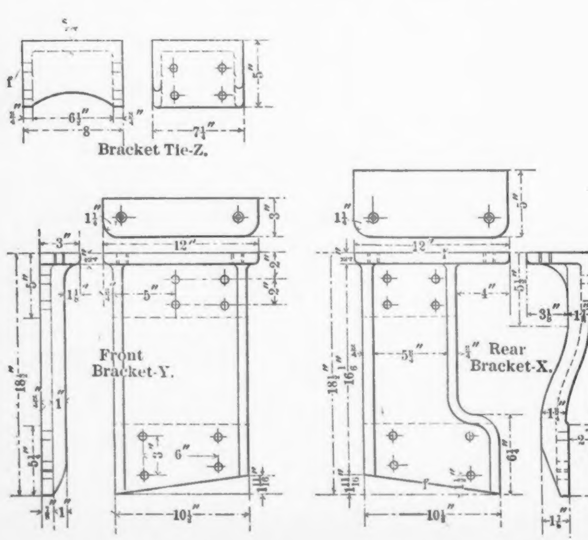


FIG. 40.—DETAILS OF THE MOTOR SUPPORT BRACKET FOR THE 18-INCH TURRET LATHE.

driving, between spindle speeds of 28 and 614-rev. per min. is 1.09, while it is much greater than this at most points.

It is no uncommon sight to see the operator of this tool change the speed for each operation provided upon the turret head, where pieces of work requiring several different operations are handled. With the belt drive, more time would usually be lost in similarly changing the speeds than would be gained by the changes, when made, and ordinarily the several different operations would be done at the same speed,

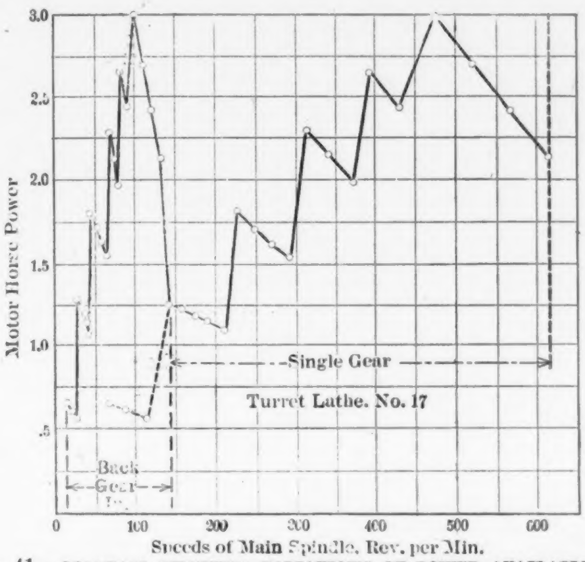


FIG. 41.—DIAGRAM SHOWING VARIATIONS OF POWER AVAILABLE AT THE VARIOUS SPEEDS OF THE MOTOR WITH THE MULTIPLE-VOLTAGE SYSTEM.

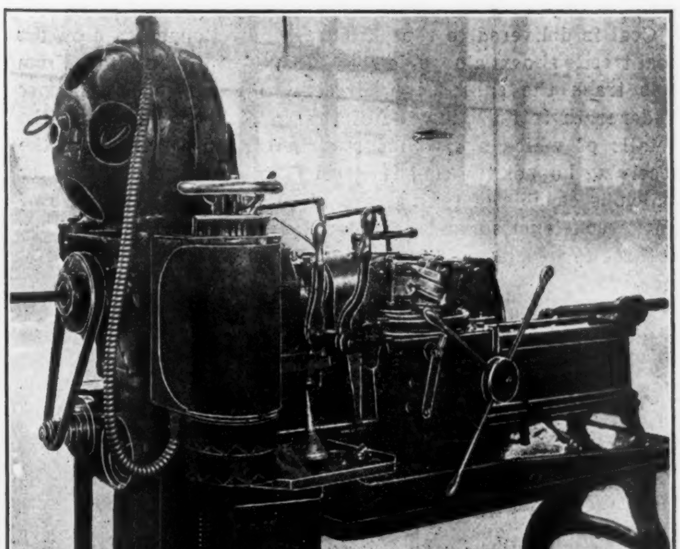


FIG. 42.—THE JONES & LAMSON FLAT TURRET LATHE, WITH THE NEW MULTIPLE-VOLTAGE DRIVE.—CROCKER-WHEELER SYSTEM.

which would be that required by the largest diameter, and thus the slowest.

Figs. 42 and 43 illustrate the application of motor driving to a Jones & Lamson flat turret lathe. This application was designed by the Jones & Lamson Machine Company, Springfield, Vt., and is very simple. The speed cone was merely replaced by a sleeve upon which the large Renold chain sprocket is keyed; the motor is supported by a plain cast iron bracket, which is made in a single piece. A light cast iron guard is provided to cover and protect the silent chain. The belt, which operates the oil pump, and which was formerly driven by a separate pulley on the countershaft, is, by the use of two idler pulleys, as shown in the end view, made to pass in through a hole in the rear side of the motor support bracket, to the sleeve on the main spindle from which it is now driven.

The controller, which is a type M.F.-21, is in this case attached to the front side of the lathe, in a manner similar to that in above-mentioned turret lathe, as shown. As this tool is rather light, a pipe was extended from the floor up to the controller to assist in carrying its weight.

The motor which is used for this drive is a Crocker-Wheeler type 5-I.-L.S.-C.M. multiple-voltage motor, developing 5-h.p. at 240 volts. The range of speed of the spindle is practically the same as that provided on the standard Jones & Lamson belt-driven turret lathe, but the number of intermediate speed steps provided is between two and three times greater. The wide range of speeds required on a tool of this type accounts for the large size motor. The nominal power provided through this speed range is about 2-h.p., but it will, of course, be greater than this at most points.

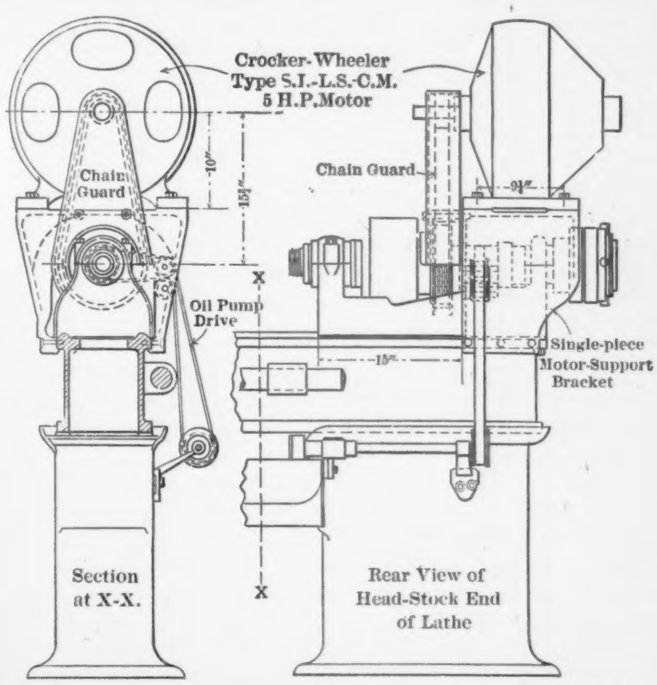


FIG. 43.—DETAILS OF APPLICATION OF THE INDIVIDUAL DRIVE TO THE JONES & LAMSON TURRET LATHE, SHOWING SPECIAL ONE-PIECE MOTOR SUPPORT.

In an exchange it is stated that standard railroad track will safely sustain from 225 to 300 lbs. per car wheel for each yard-pound of rail.

The Hudson River tunnel of the New York & New Jersey Railroad Company is almost completed, only about 300 feet remaining to finish the tube. Soon after March 1 the projectors expect to be able to join the headings and pass the first car across under the river. The finishing of the structure and construction of equipment will soon follow. It is understood that the cars will be absolutely fireproof.

The New York, New Haven & Hartford Railroad have large improvements under way at Bridgeport, Conn., involving line straightening, track elevation through the city, a new rolling-lift bridge, and a large new station. Important new work will soon be undertaken to increase the capacity of several large bridges on the main line between New York and Boston, which are old and prevent the running of locomotives weighing more than 157,000 lbs., and it is not considered safe to run loaded cars of 100,000 lbs. capacity. The allowable loads of both locomotives and loaded cars on many of the branches are much less, and in many cases are such as to make the operation of the branches complicated and unduly expensive.

AN IMPORTANT NEW TERMINAL-YARD LIGHTING AND POWER PLANT.

WEEHAWKEN, N. J.

WEST SHORE RAILROAD.

II.

With an Inset.

(*Continued from page* 46.)

The details of construction of the power plant building, which were briefly referred to in the preceding article, are herewith shown in the engravings presented in the accompanying inset. By reference to the cross section drawings, the important features of building construction, as well as the arrangement of apparatus within, may be seen. A longitudinal elevation of the boiler room is also presented in addition to the plan drawing; the longitudinal elevation of the engine room will appear in the following issue.

One of the most noticeable features of the power house is that the basement is located above ground level, the basement floor being on a level with the base of rail level of the adjoining terminal yard tracks; the ground level is just below the water table of the building, and but a few inches above maximum high tide. This brings the basement high enough to make it not only light and conveniently accessible, but also to permit of its being kept well ventilated and dry—this is important in power plant conditions. Ample head room of nearly 12 ft. is provided in the engine room basement; under the boiler room 8 ft. between floor levels is provided.

An important feature of the arrangement of the building is the provision for bringing machinery into the engine room. At the south end of the basement there is a large double door, with an opening 9 ft. 8 ins. wide by 8 ft. 6 ins. high, through which large pieces of machinery may be delivered onto the basement floor. In the engine room floor over the space immediately in front of this wide double door, there is a large hatch opening, 12 ft. square, through which the hoisting hook of the engine room traveling crane may be lowered to hoist the weight. This makes a most convenient method of bringing the heaviest pieces into the engine room. The hatch opening is protected by a 3 ft. railing of pipe construction, which may be removed when desired.

The massive character of the foundations for the engines and stacks is well shown in these drawings. All the heavier foundations rest on piling, the piles having been driven down to rest on solid rock. The footing courses of the walls are laid upon scrap rails to spread the weight, and is carried upon piles driven to solid rock. As before stated the foundations are all of concrete, composed of one part of Portland cement to two parts of clear, sharp sand and four of broken stone, and they were laid very carefully without joints so as to form a solid monolithic structure in each case. The foundation for the brick stack was built extra heavy to provide for possible extension; the original height of the stack is to be 225 ft., but the foundation is proportioned for an increase of its height by 50 ft., should the property on the Palisades above, become a residence district. This foundation is square at the base, but changes in section to octagonal a short distance below the boiler room floor, and the shaft to a circular section just below the roof.

The steel work of the building is particularly heavy and substantial. The general design of the roof trusses may be seen from the cross sections. In the engine room they have a clear span of 52 ft. from wall to wall. The boiler room trusses extend only to the columns at the face of the boilers, the columns are connected longitudinally and to the face of the exterior wall by plate girders, which support the coal and ash storage bins, thus leaving the space above clear for the conveying apparatus, as shown.

The craneways in the engine room, which consist of 42-in. steel plate girders, located 50 ft. between centers, are carried on the tops of the heavy steel columns in the side walls, which are spaced 35 ft. between centers. The stairways, to the galleries, between floors, etc., are built up of 10-in. channels with cast iron treads, and are provided with 3-ft. railings of pipe and fittings, which are also used to protect the gallery, the wheel pits around the engines and the hatchway opening in the engine room.

COAL AND ASH HANDLING SYSTEM.

A very complete system of conveyors and elevated storage hoppers has been provided for the handling and storage of coal and ashes. The arrangements of this system, which comprises a transverse belt conveyor to carry the coal from the receiving hopper and a longitudinal bucket conveyor to elevate the coal or ashes to the storage bins above, are well shown in the accompanying drawings in the inset. This, in conjunction with a coal trestle at the rear of the building by means of which car loads of coal are dumped directly into a receiving hopper and crusher, provides a perfectly automatic system of coal and ash handling, the capacity of which is for handling 30 tons of "run-of-mine" coal, either anthracite or bituminous, per hour.

The elevated pockets for coal, of which there are four, are of steel construction, as shown. They are large, 13½ by 15 ft. square at the top; the chute opening at the bottom is 19 ft. above the boiler room floor. The two ash pockets are of similar construction, but slant toward the outside wall, instead of toward the boilers, in order to deliver into cars on the coal trestle outside. These hoppers are carried partly on the side wall construction and partly by steel columns rising at the boiler fronts, which extend up to the roof trusses. Each hopper has a capacity of 35 tons of coal, making a total storage capacity of 140 tons of coal in all; the ash hoppers are calculated to take care of a three days' accumulation of ashes.

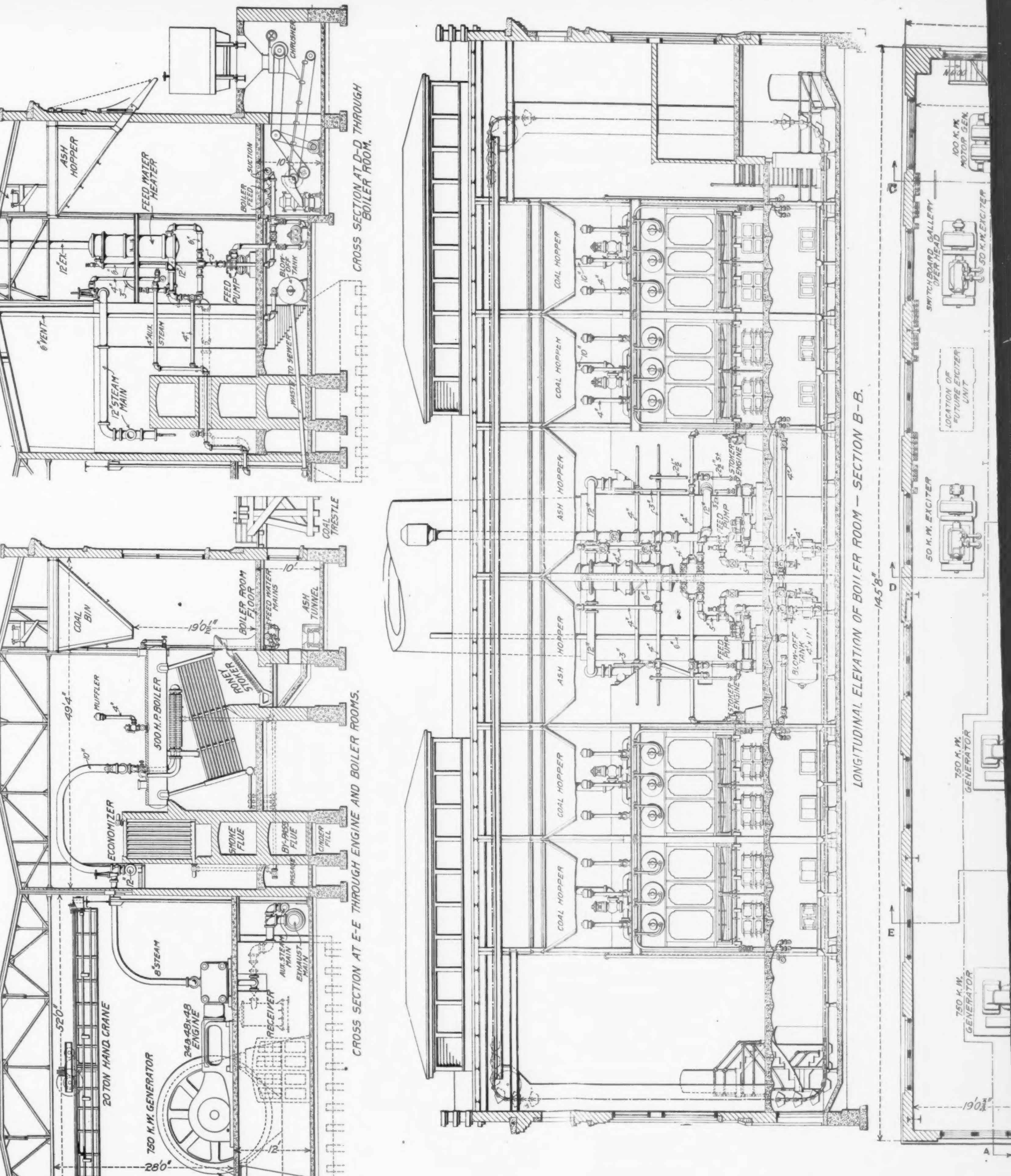
Coal is delivered to the power plant by hopper cars on the coal trestle shown alongside the rear wall of the building. From this track the cars dump direct into the receiving hopper underneath in an extension of the boiler room basement, the details of which are well shown in section D-D. From the receiving hopper the coal is directed into a large coal crusher which is capable of taking care of 30 tons per hour; it is of heavy construction and capable of reducing lumps in either anthracite or bituminous, to sizes suitable for the Rony stokers.

From the crusher the coal is delivered into the conveyor system, which consists of a belt conveyor, leading transversely a distance of 18 ft., and a bucket conveyor, receiving the coal from the belt conveyor and carrying it to the storage pockets, without manual labor. The belt conveyor is of the usual type, 18 ins. wide, and is designed for a belt speed of 400 ft. per minute. The main bucket conveyor is of the usual link type, with pressed steel buckets, 18 by 26 ins. in size at the top and spaced 28 ins. between centers in the driving chain. Automatic trips are located over the storage pockets to dump the buckets in any desired location. This conveyor is driven by a reversible, variable-speed three-phase alternating-current motor, the transverse belt conveyor and the coal crusher being driven through a countershaft by a similar but non-reversible motor.

Ashes are discharged into the main bucket conveyor directly from the ash pits under the boilers, as shown, an apron being provided to permit their being scraped into the passing buckets. After accumulating in the ash hoppers above, they are dumped into cars standing upon the trestle track at the rear and drawn away. The details of the discharge chute leading through the wall and cut-off gate outside, are well shown in section D-D. This entire conveyor equipment, including the crusher, will be furnished and installed by the Exeter Machine Works, Pittston, Pa., under a rigid guarantee for efficient and satisfactory operation.

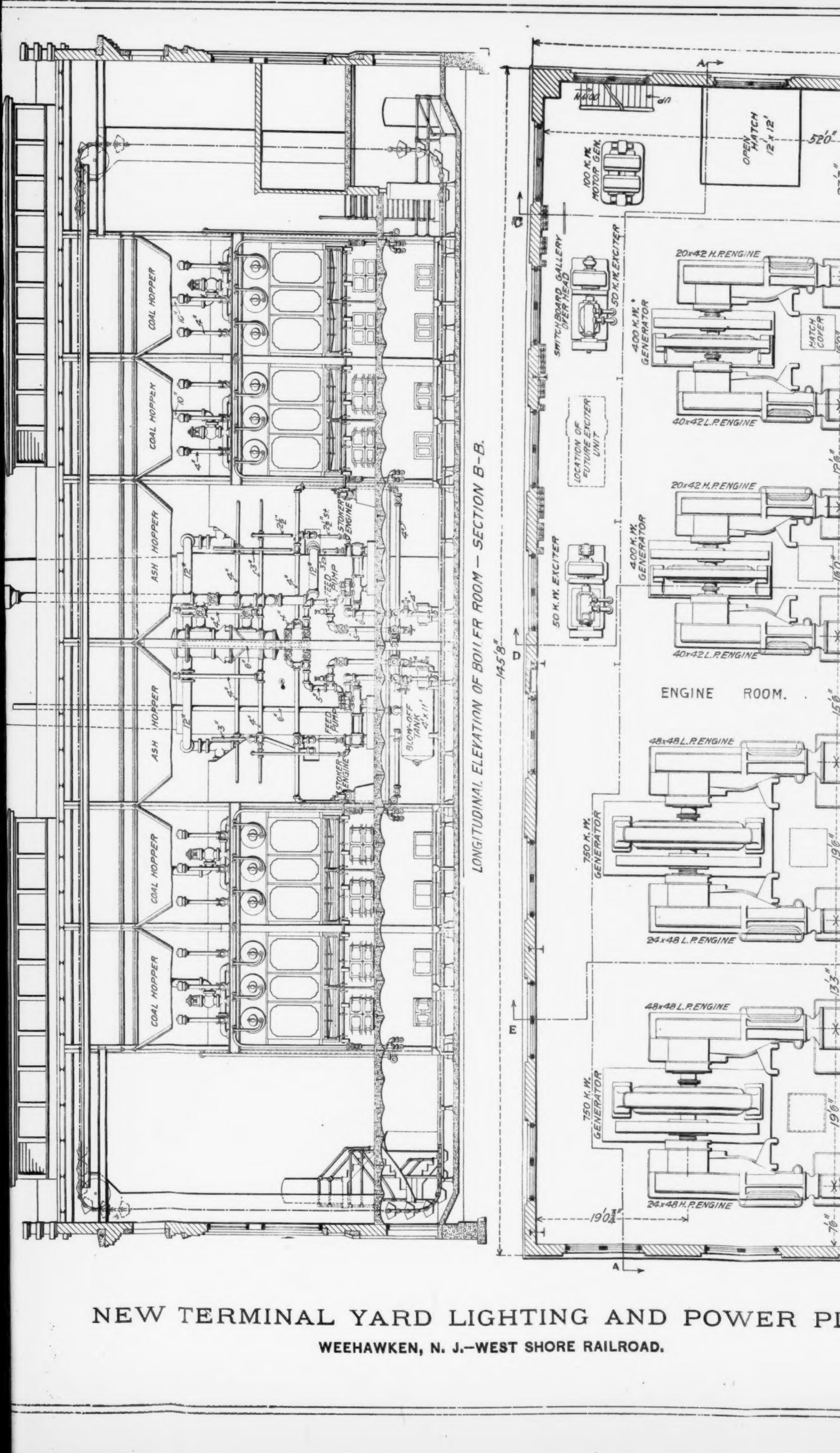
BOILERS, STOKERS AND SUPERHEATERS.

The boiler equipment consists of four 500-h.p. horizontal water-tube boilers, set in two batteries of two each, one on either side of the stack. The boilers were built by the Aultman & Taylor Machinery Company, Mansfield, Ohio, and each



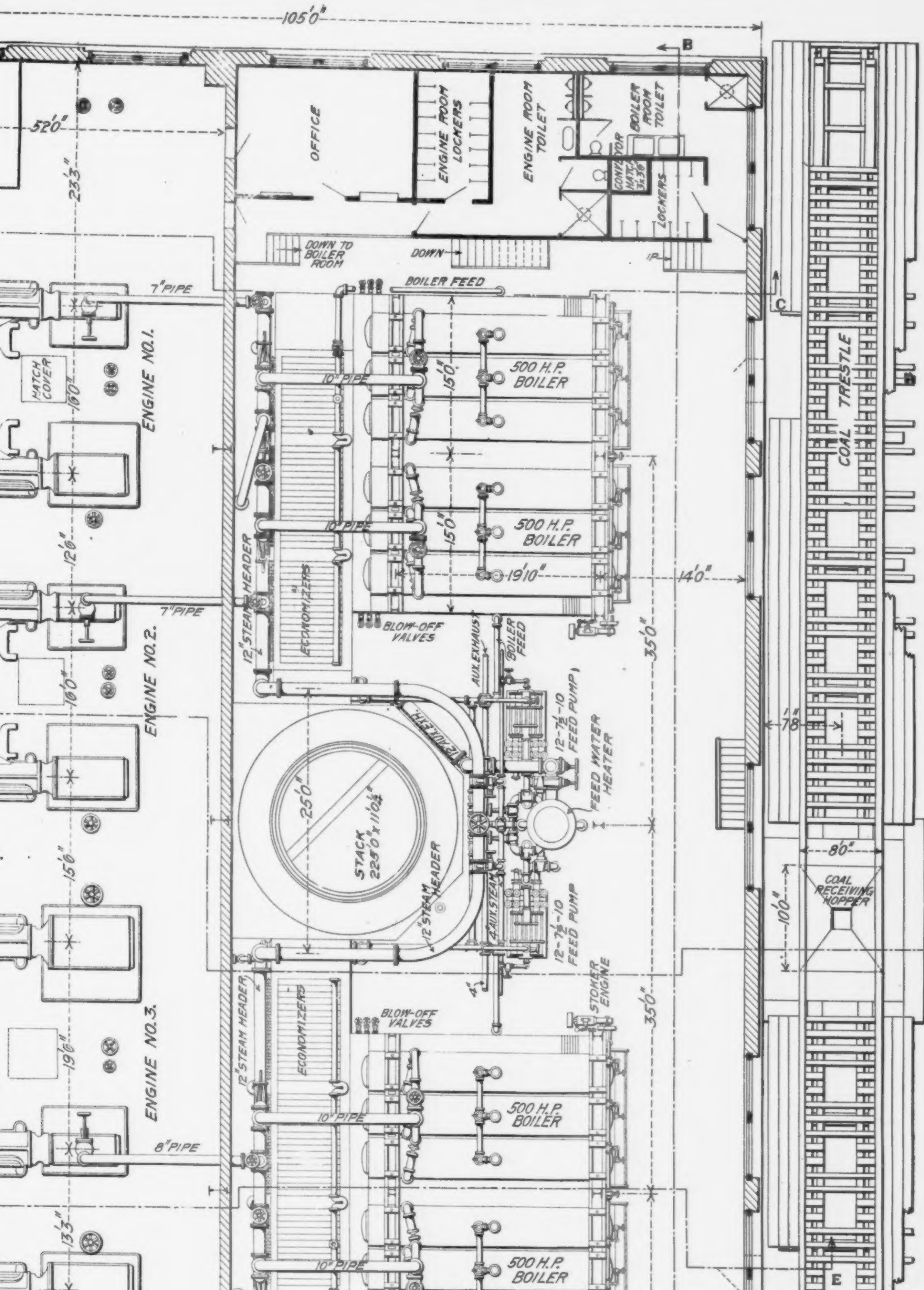
NEW TERMINAL YARD LIGHTING AN

WEEHAWKEN, N. J.—WEST SHORE RAILROA



NEW TERMINAL YARD LIGHTING AND POWER PL

WEEHAWKEN, N. J.–WEST SHORE RAILROAD.



PLAN OF THE ENGINE AND BOILER ROOMS.

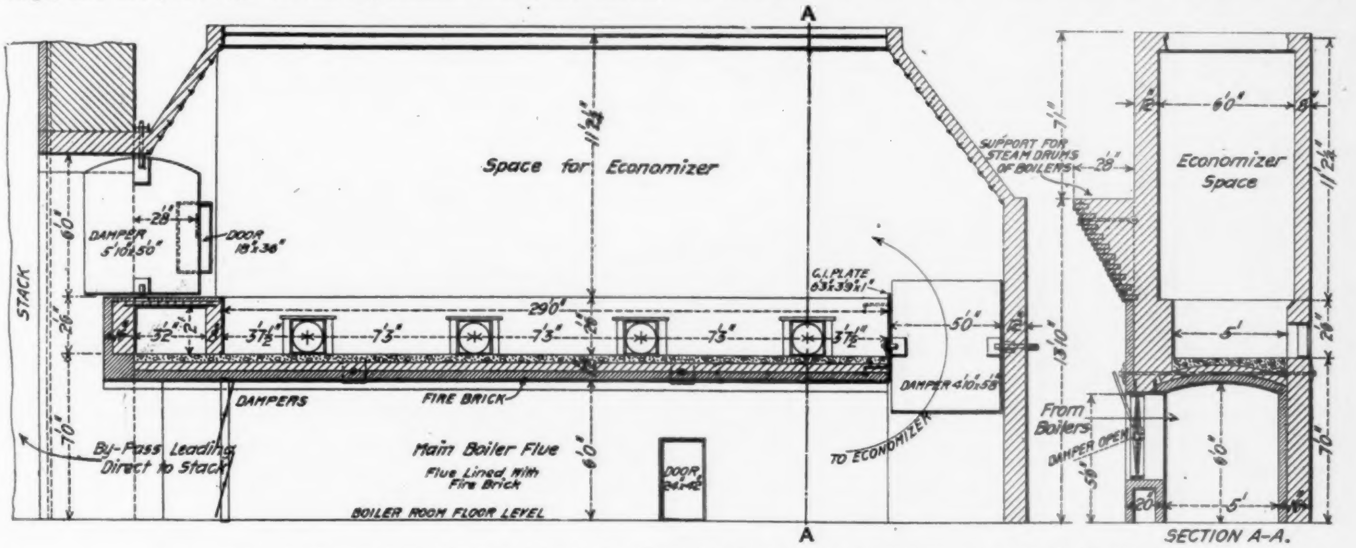
R PLANT.

EDWIN B. KATTE, *Electrical Engineer.*

is equipped with a Foster superheater supplied by the Power Specialty Company, New York. The rating of the boilers is based upon 10 sq. ft. of heating surface per boiler horse-power, and also upon the A. S. M. E. standard of 30 lbs. of water evaporated per hour from feed water at 100 degs. F., to steam at 70 lbs. pressure, and they are designed for 50 per cent. overload capacity.

The boilers are carried upon wrought iron supports, entirely independent of the brick work, and expansion is carefully provided for to insure air-tight settings. The details of the settings, and the provision for the superheater tubes, are shown, nections for by-passing, so that the boilers may deliver saturated steam, if desired. The superheater fittings are of extra heavy cast iron, of special mixture for this service. The superheaters are designed to raise the temperature of steam delivered from each boiler, at its rated pressure of 150 lbs. per sq. in., to 550 degs. F.; this provides that the temperature be measured at points in the main steam header 5 ft. beyond the boiler, and with the furnace gases leaving the boiler at not over 600 degs. F.

The stokers are the well known Roney stokers, installed by Westinghouse, Church, Kerr & Co., and are arranged for easy



DETAILS OF THE FLUE CONSTRUCTION AND ECONOMIZER SETTING, SHOWING BY-PASS TO STACK.

in general, in the drawings. All brickwork showing at the fronts is of white enameled brick. Further interesting details of the boiler equipment are given in the following table:

BOILERS.

Nominal Horse Power	500 H. P.
Heating Surface	5,000 sq. ft.
Working Pressure	150 lbs.
Test Pressure after erection	200 lbs.
No. of Sections	21
No. of Tubes	252
Kind of Tubes	"Knobbled," Hammered Charcoal Iron
Diameter of Tubes	4 inches
Length of Tubes	18 ft.
No. of Steam Drums	3
Length of Steam Drum	23 ft. 3⅝ ins.
Diameter of Steam Drum	36 ins.
Thickness of Steam Drum Plate	⅜ in.
No. of Mud Drums	1
Diameter of Mud Drum	12 ins.
Length of Mud Drum	12 ft. 6 ins.
Thickness of Mud Drum Plate	1¼ ins.
Size of Steam Opening	10 ins.
Number and Diameter of Dry Pipes	3—5 in.
Outside Dimensions of Setting	23 ft. 3 ins. by 15 ft.
Maximum Height of Boiler Above Floor Level	18 ft. 3 ins.
Shipping Weight per Battery	196,000 lbs.

SUPERHEATERS.

Type	Flue Fired
Square Feet of Superheating Surface	1,250 sq. ft.
No. of Tubes	24
Diameter of Tubes	4 inches
Shape of Tubes	⊃
No. of Sections	3
Diameter of Connections to and from Superheater	3—5-in. pipes

STOKERS.

Type	Roney Overfeed
Width, Over All	12 ft. 6 ins.
Length, Over All	8 ft. 2 ins.
Grate Area	112 sq. ft.
Weight, Each	21 600 lbs.
Size of Stoker Engine	4½ in. cylinder diameter, and 4-inch stroke
Horsepower of Stoker Engine, at 80 lbs. steam pressure	5 H.P.
Horsepower Required to Operate Each Stoker	1 H.P.
Draft Required by Stoker, inches of Water	¾
Draft Required at 150 per cent. Overload, Inches of Water	½
Rating, Coal per sq. ft. of Grate per Hour	15 lbs.
150 per cent. Overload Rating, Coal per sq. ft. Grate per Hour	22 lbs.

The boilers are equipped with safety high and low water alarms, which, together with the other boiler fittings, are finished in polished brass. The feed and other auxiliary pipe connections are of heavy brass and the blow-off piping is fitted with flange connections. A special feature of the boiler and superheater construction is that all joints are made, metal to metal, without packing of any kind. The tubes of the boiler are expanded into "flowed" steel headers.

The superheaters, as shown in cross-section E-E, are located in the setting above the water tubes and form an integral part of each boiler. They are, however, provided with proper con-

renewal of grate bars and sections. Each battery of two stokers is operated by a Westinghouse special stoker engine, each of which engines is large enough to operate all the stokers in case of accident. With coal supplied in proper size and proper firing, the stokers are guaranteed to consume the coal completely and smokelessly. A special feature of the furnace design is that they are proportioned for burning refuse dust and clippings from the grain elevators—an important economic feature under these conditions.

ECONOMIZERS.

Two fuel economizers will be installed in the smoke flues at the rear of the boilers by the Green Fuel Economizer Company, which are utilized for heating the boiler feed water. Their location is shown in the plan and on cross-section E-E, and the details of the setting, together with the flue connections to the boiler, and the by-pass to the stack, are shown in the accompanying drawing on this page. Each unit consists of eight vertical cast-iron tubes, connected to headers at top and bottom, each row forming a section. All joints are metal to metal with machined contact faces. The feed water enters at the cooler end of the flue and leaves at the end nearest the boiler. The usual scraping devices are employed for removing soot from the tubes, which are driven by three-phase alternate-current induction motors. The principal features of the economizers are indicated in the following table:

ECONOMIZERS.

No. of Tubes in Each Section	8
No. of Sections in Each Economizer	44
Length and Diameter of Tubes	10 ft. by 3⅞ ins. diameter
Total Heating Surface of Each Economizer	4,576 sq. ft.
Power Required to Operate Scrapers	2 H.P.
Size of Scraper Driving Motors	2 H. P.
Test Pressure for Economizer and Fittings	350 lbs. Hydrostatic

The economizers are guaranteed to raise the temperature of the feed water passing through them, according to the conditions of load, as given below:

Load on Boiler.	Temp. Gases Entering.	Temp. Gases Leaving.	Temp. Feed Water Entering.	Temp. Feed Water Leaving.
500—B. H. P.	450° F.	210° F.	100° F.	210° F.
1,000—B. H. P.	550° F.	342° F.	100° F.	200° F.
1,500—B. H. P.	650° F.	460° F.	100° F.	185° F.

FLUES AND STACK.

The stack is of the radial brick type and is of ample size to easily handle normal and 50 per cent. overloads on the present boiler equipment and the two additional boilers for which space is reserved. It is 225 ft. high, with an internal diameter of 10 ft., but is proportioned for an increase of 50 ft., or 275 ft. future height. The stack foundation is of concrete on piles, and ends at 8 ft. below the boiler room floor level. The base of the stack is square, but changes to half octagonal above the boiler room floor; the base ends and the chimney, which is round in section, begins just above the economizers. The chimney was built to a special design by the Alphons Custodis Chimney Construction Company. Its principal dimensions are as follows:

STACK.

Height Above Foundation	233 ft.
Height Above Boiler Room Floor	225 ft.
Height of Base Above Foundation	33 ft.
Side of Base, Outside	22 ft. 2 ins.
Diameter of Base, Inside, At Top	13 exposed ft. 10 ins.
Diameter of Base, Inside, At Bottom	13 ft. 2 ins.
Height of Round Shell	200 ft.
No. of Sections of Shell of Different Thicknesses	13
Weight per Cu. ft. of Radial Brick	120 lbs.
Thickness of Fire-Brick Lining in Base	4½ ins.
Width of Air Space Between Lining and Shell	2 ins.
No. of Flue Openings	5
Wind Pressure Designed for	50 lbs. per sq. ft. of exposed surface

There are five flue openings, two on each side above the boiler room floor, as shown, and one below, on the side opposite from the office, which was installed to provide connection for the two future boilers. The details of the connections at the rear of the boilers leading to the economizer settings and to the by-passes, are made clear in the accompanying drawing. The main boiler flue, below, has a row-lock fire-brick arch over it; this is covered with a similar arch of common brick and then bedded over deeply with a strong cinder concrete for the floor of the economizer chamber. The economizer space is roofed at the sloping ends with courses of brick laid on cast-iron tees, spaced 9 ins. apart, and covered with a cement mortar. The arrangement of dampers for diverting the flue gases through the economizer, or by-passing, is clearly shown. The base of the stack is provided with a 12-in. baffle wall of fire brick, built diagonally across between the flue openings, to take the impact of the entering hot gases. This wall is spaced, as shown in the plan, to one side of the center to provide for the future boiler capacity.

(To be continued.)

NEW LOCOMOTIVE AND CAR SHOPS.

McKEES ROCKS, PA.

PITTSBURGH & LAKE ERIE RAILROAD.

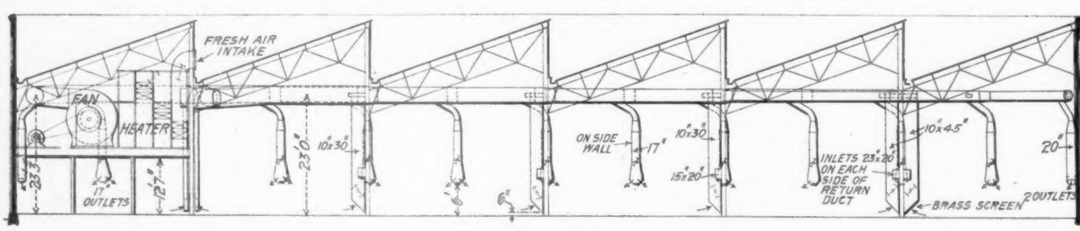
IV.

THE PAINT SHOP.

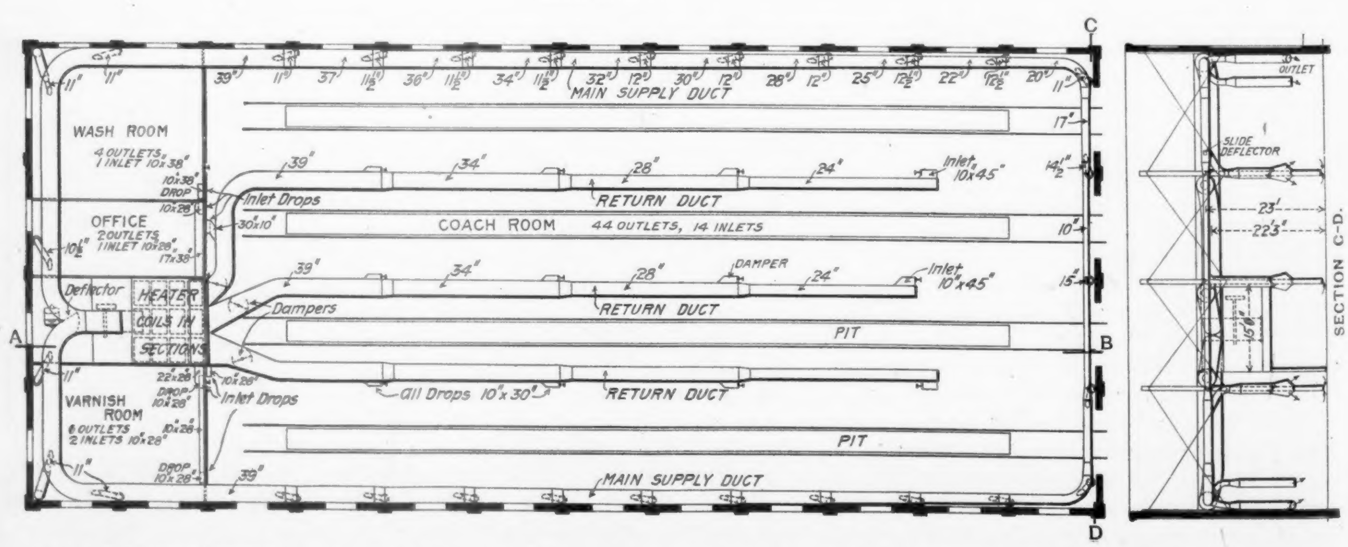
As may be noted by referring to the layout plan of the McKees Rocks shops, which was presented on page 396 of the November, 1903, issue, the paint and color shops are peculiarly located with respect to the remainder of the shop plant, being situated in a convenient Y-shaped corner formed in the west side of the shop grounds by existing track locations outside; they are not far removed from the main buildings, but are still far enough, being located nearly 200 ft. from the nearest corner of the main locomotive shop building, to protect them in case of a dangerous fire in the paint stores. Convenient access is had to both paint and color shops by tracks leading from the west side of the shops.

The paint shop involves some interesting features, both as to construction and as to facilities. It is a steel frame building, with saw-tooth roof construction to provide ample daylight lighting, as shown in the accompanying half-tone engravings. The general features of the building construction are well shown in the accompany sectional drawings and in the detail of roof construction, which shows also the details of the steel column construction. The outside appearance of the paint shop is greatly modified, however, and the usual peculiar exterior so noticeable in most saw tooth roofs, is avoided, by carrying the side walls above the ridges of the saw teeth; this permitted harmonizing the general exterior appearance with that of the other buildings of the shop group.

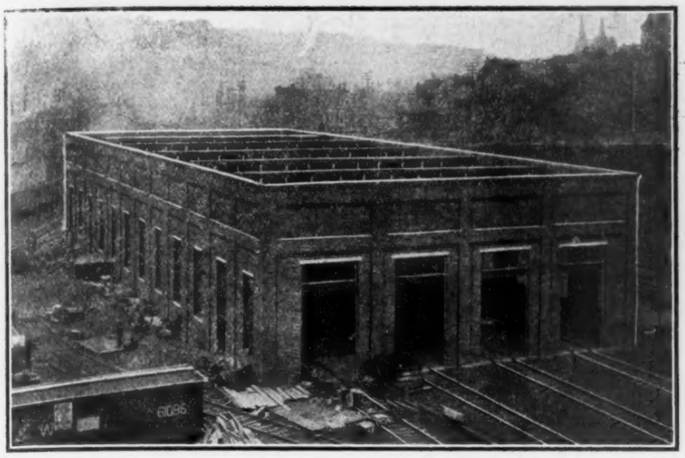
The paint shop, as shown in the plan drawing, is 204 x 85



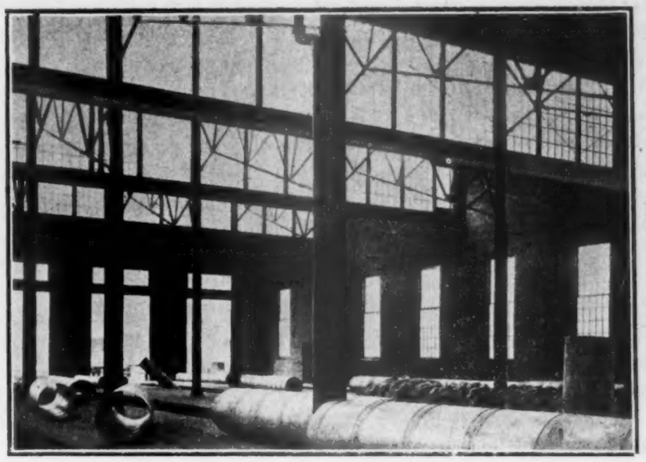
SECTION A-B.



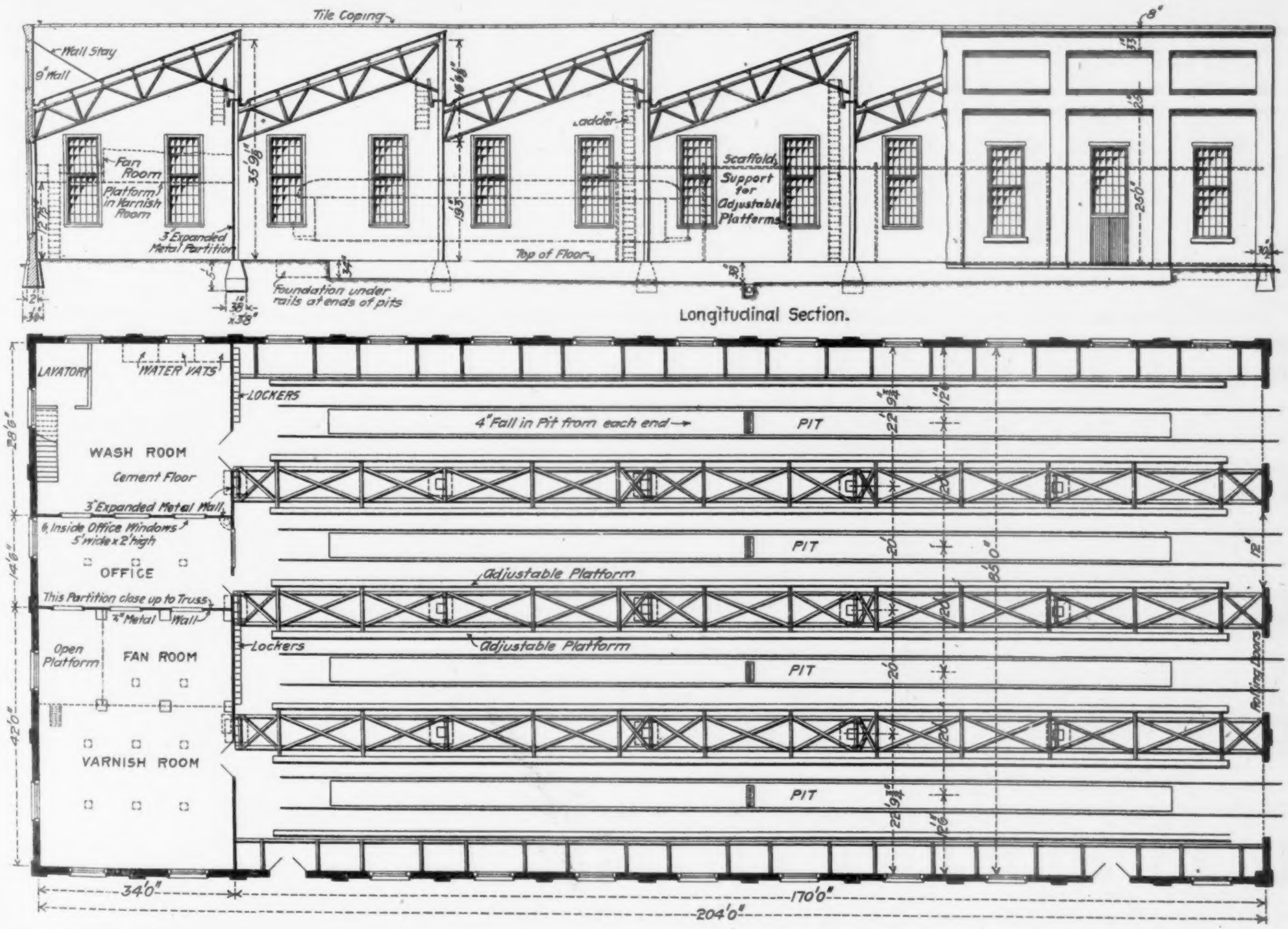
PLAN OF HEATING SYSTEM: ARRANGEMENT OF DELIVERY AND RETURN HEATING DUCTS FOR RECIRCULATING SYSTEM IN PAINT SHOP.



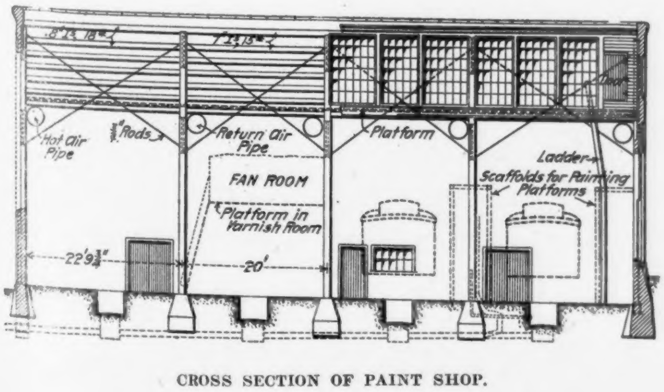
VIEW OF THE EXTERIOR OF THE PAINT SHOP BUILDING. (TAKEN FROM ROOF OF ERECTING SHOP.)



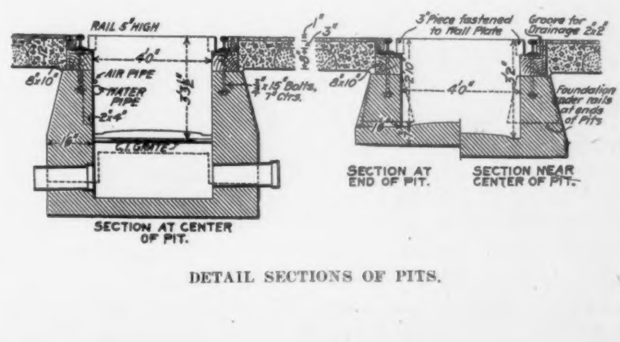
INTERIOR VIEW OF PAINT SHOP, SHOWING PROFUSE CHARACTER OF THE DAYLIGHT LIGHTING FROM THE SAW-TOOTH SKYLIGHTS.



PART LONGITUDINAL SECTION AND PART ELEVATION, AND PLAN OF THE PAINT SHOP, SHOWING ARRANGEMENT OF FRAMEWORK BRACING FOR ADJUSTABLE SCAFFOLD SYSTEM.



CROSS SECTION OF PAINT SHOP.



DETAIL SECTIONS OF PITS.

McKEES ROCKS SHOPS.—PITTSBURG & LAKE ERIE RAILROAD.

ft. inside, with a clear distance of 19 ft. 3 ins. under the lowest portions of the roof trusses. The roof is supported between walls by three rows of steel columns, of five columns each, dividing the building into six sections. The section at the south end, 34 ft., is partitioned off to provide accommodations for the washing and varnishing departments, office, etc., which are arranged across this end of the building, as shown; the partitions are built of concrete, 3 ins. thick, on expanded metal, all of which are carried up to the roof trusses or roof. A most light and convenient shop has been secured; the character of the daylight lighting, which is northern exposure, may be judged from the interior view of this building looking toward the saw-tooth skylights. The convenience of the workmen is provided for in an excellent arrangement of lavatories and water closets in one corner of the washing room; the water closets are located on an elevated platform or gallery, 9 ft. above floor level, beneath which are the lavatories.

Four longitudinal tracks lead into the paint shop, spaced 20 ft. 0 ins. between centers, as shown on the plan. These tracks extend 165 ft. into the building, or within 15 ft. of the partition across the south end, and are provided with pits which are of concrete construction, as is the floor throughout the building. The construction of these pits is shown in the detail cross sections, one at the drainage point at the middle and the other at different points of depth; each pit is 140 ft. long and 34 ins. deep at the ends, dropping to 38 ins. deep at the drainage points at the middle. The drain connections are shown in the cross-section view of the buildings; each drain is covered at the pit by a cast-iron grating. A feature of this building is also to be found in the system of inside roof drainage and the provision of steam heating pipes (see detail of roof construction) beneath the gutters to thaw out ice that may form there in winter.

HEATING AND VENTILATING SYSTEM.

One of the most important features of this shop is the heating and ventilating system, which was designed with great care to properly fulfill the special requirements. The requirements of the modern paint shop in this particular were very concisely stated by Mr. W. O. Quest, master painter of the P. & L. E. R. R., in a recent paper before the Railway Club of Pittsburgh, as follows:

"The essentials of heating and ventilating a railway paint shop according to requirements, should be so mathematically adjusted as to conform to interior shop space in such a manner as to prevent these opposite elements from conflicting with shop cleanliness. A controlled volume of circulated air should be secured through a series of easily manipulated ventilator openings located in the ceiling, or other similar mechanical appliance that will insure a fresh air supply, and at the same time prevent the generated heat from being carried away from work line of shop. Without question, all heat should be either generated or discharged at a low floor line, in order that all moisture resulting from car washing, etc., will quickly dry up. According to the available practical authority, the installation of the recirculating system of hot air heating and ventilating, the shop should be so constructed as to insure a fifty to sixty per cent foul air displacement in a given time, as it is claimed that the constant churning over of foul air of a paint shop, without taking in at least fifty per cent of fresh air hourly from outside, will be productive of bad results in the form of both moisture and a poisonous gaseous air, which are extremely injurious to both fresh applied paint and varnish and to the health of the men compelled to work under such conditions. There is an inevitable law that all heat ascends and never descends only when in such volume as to entirely displace the pure air, showing conclusively that all heat should be generated as near floor line as possible, which will, with necessary top ventilation, produce an ideal shop atmosphere on an old established law which, when put to the test, usually shows that it is the most practical, and not the most scientific of heating and ventilating system that is wanted in the railway car paint shop."

On account of the importance of this subject, as well as the excellent manner in which these requirements were provided for at this shop, we illustrate the heating system in detail. It consists of a motor-driven ventilating blower equipment, located in the varnish room, and connected up with return suction and delivery pipes for recirculating the air in the shop. The main delivery ducts extend under the roof around the outside walls of the building as shown on the ventilating system plan; the delivery outlets, which are spaced 17 ft. apart, extend down the side walls to within 6 ft. of the floor, and are provided with double-ported deflector openings to divert and scatter the hot blast. The return ducts are carried under the roof along the three lines of roof-supporting columns and the suction openings extend down at every column with large screen-covered openings at the floor. These delivery and return mains, as well as the outlets, are all of galvanized iron ducts of sizes shown on the plan.

The motor and fan are mounted, at an elevation of 12 ft., above the floor, upon a structural iron platform, along the west side of the varnish room, which forms a gallery with a clear height underneath of 11 ft. This platform also carries the heating coils for adjusting the temperature of the air delivered through the shop. The return suction mains lead to the casing of this heater and the fan takes its suction from the delivery side of the heater; a connection is provided on the intake side of the heater with the roof so that fresh air may be added to the air circulation, as desired, to effect the desired displacement of foul air. Dampers are liberally provided in all intake and delivery outlets and connections, so that the flow of air, and the general temperature effect can be adjusted in a most flexible manner. The low delivery points for the hot blast, and the arrangement of intake openings at the floor to remove the lower strata of cold air, are the important and remarkable features of this system.

NEW DESIGN OF ADJUSTABLE SCAFFOLDING.

A scaffold system of an entirely new and original design has been installed in the paint shop, which is worthy of particular notice. The details of the notched supporting posts and method of bracing them from the main columns of the building, as well as of the malleable iron adjustable brackets used on the posts, are shown in the accompanying detail sketch; the arrangement of the scaffold posts and trussed bracing structure, between the pit tracks, is shown in the plan view of the building.

The method of operation is as follows: Each notched post has on it one of the adjustable brackets, which will rest at any notch along its length, as shown on the end elevation. To raise these brackets, which carry the sectionalized scaffold, it is only necessary to pull down on hoisting rope, H, which acts over the pulleys and lifts the brackets up until they catch in higher notches; in lowering the scaffold, the lowering rope, L, is pulled down sufficiently to unlatch the bracket from the notch it is resting in, after which it may be allowed to descend by paying out on the hoisting rope. Inasmuch as the weight of the scaffold comes on the outer edge of the bracket, it will very quickly seek a notch and settle in it. The details of construction of these brackets are very clearly shown in the accompanying detail drawing; it will be noted that pipe rollers are provided in the handle, on the inside, so as to prevent binding in raising and lowering.

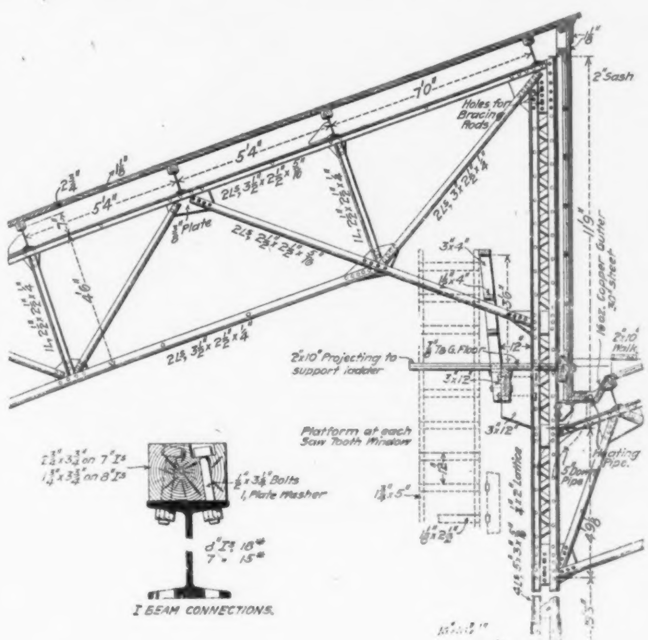
An interesting feature of this scaffolding is that the painters can very easily raise or lower the platform while they are on it. By placing one foot on the handle at the rear of the notched post and pulling down on rope, H, they bring the bracket to an unlatched position, after which the platform may be moved up or down; this is made possible by the act of stepping over onto the handle at the rear, which takes part of their weight off the platform. The very interesting and remarkable feature of the scheme is that the constant tendency of the bracket is to seek a supporting notch, so that there is no possibility of dropping; the bracket is tilted into the lowering position only by pulling rope, L, very forcibly, as the scaffold must be lifted; and if rope, L, is quickly slackened the bracket will instantly seek the next lower notch and thus not fall any distance. It is practically impossible to move the scaffold while anyone is on it, as their weight acts so strongly in holding the bracket in the notch.

The platforms are built in 14-ft. lengths, and are flexibly connected at the joints; this permits of one section being raised a notch higher or lower than those next to it at either end. A detail of the joint in the platform is shown on the scaffold drawing. By this means the sections of the platforms are held tightly together lengthwise, but are very flexible for

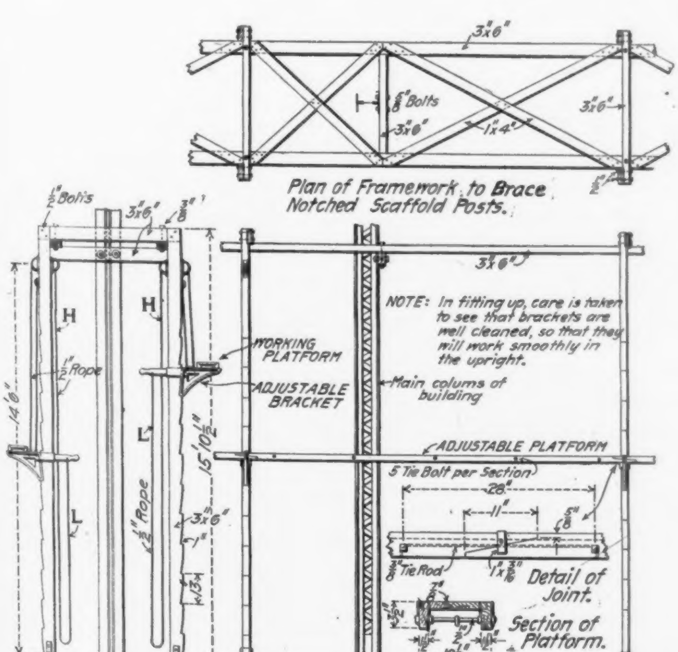
raising and lowering. This interesting and valuable system of adjustable scaffolding is the invention of Mr. W. O. Quest, the master painter of this road.

THE COLOR SHOP.

The color shop is a neat brick building, 30 x 60 ft. in size, which is to be used for storing paints, oils, supplies, etc., and is



ROOF TRUSS CONSTRUCTION OF PAINT SHOP.

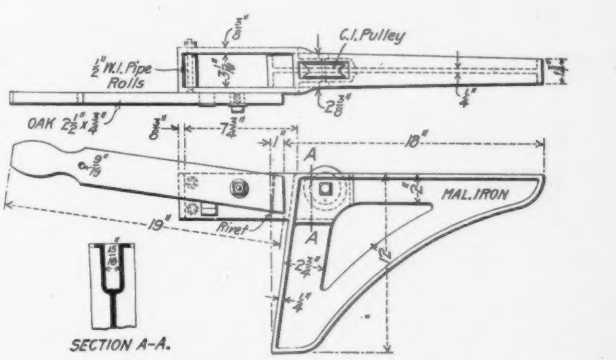


DETAILS OF THE ADJUSTABLE SCAFFOLD SYSTEM FOR THE USE OF THE CAR PAINTERS IN THE PAINT SHOP.

located about 40 ft. to the east of the paint shop. A spur track runs along its west side which is equipped with an unloading platform for direct handling of barrels, etc. Besides the use for storage, the basement of this building is to be fitted up for a modern glass etching, mirroring and embossing plant, and to accommodate sign work and the cutting of standard freight car stencils—a very convenient and useful equipment for the modern railway paint shop.

Power hoist devices for handling ash pit refuse do not appear to increase in popularity. The old fashioned pit with inclined tracks for the cinder cars seem now to be decidedly preferred. Power devices depend upon the power and this part of the plant is tied up by a burst pipe or a leaky gasket, a wornout packing leather or a broken cable. At one large roundhouse it has been found necessary to discard an elaborate air hoist device in favor of an ordinary pit. The number of men required to clean fires is sufficient to clean the pit at times when the other work is not pressing. The officer responsible for this change says he would rather put the cost of the air hoist into another pit and pit tracks in order to clean fires quicker. Of course air hoists can be made to work; but unless great capacity in storage of ashes is provided, the device is likely to be "snowed under" in a time of stress and then the whole thing must be shoveled out—a most inconvenient job. The ideal arrangement seems to be a pit track raised on stilts above an incline of concrete with a cinder car track at a lower level and beside the pit track, so placed as to render the shoveling easy. All that then remains is to put in enough tracks to permit of passing the engines quickly and to make the tracks long enough so that they will not quickly clog up with ash and cinder.

High cutting speeds are specially interesting when accomplished on old machines. In an out of the way corner of a locomotive shop, our representative found an old Niles 36-in. axle lathe which was speeded up to a cutting speed of 51¾ ft. per minute in axle turning. With one of the new tool steels it was taking a ¼-in. cut at ⅛-in. feed at this speed. In the same shop is a ten-year-old, 42-in boring mill. It is too feeble to carry a heavy cut on large works and is used to bore out driving boxes. A large box is set, faced and bored in 30 minutes and the machine does this work very well. The boring alone is often done in eight minutes.



DETAILS OF THE BRACKET USED ON THE NOTCHED POSTS TO CARRY THE ADJUSTABLE PLATFORM.

Large compound locomotives must be provided with devices to facilitate drifting without overheating the cylinders. They are usually liberally provided with relief bypass and water valves and these, with the piston rod and valve stem packings, frequently leak and sometimes enough steam escapes to obscure the view of the engineer. It is strange but true that this difficulty is made the basis of an argument against the compound locomotive in general. Such a complaint is a surprising confession of helplessness, but it is often heard and is not confined to any particular type of compound. The circulating pipe used so successfully on the Southern Pacific meets this difficulty perfectly, except as to the leakage of piston rod and valve stem packing. With piston valves a circulating device is necessary for all cylinders and specially is it necessary for large low pressure cylinders where much drifting is done. The time is past for saying that "compounds are all right for level roads, but on mountain roads the fuel saved on up grades is lost again in drifting."

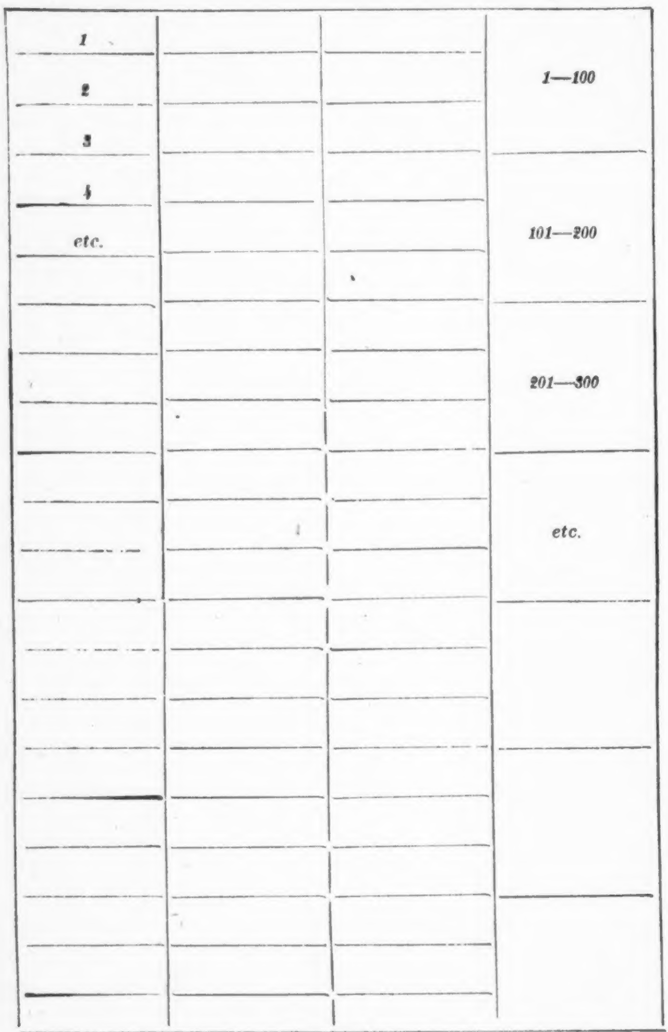
RAILROAD SHOP MANAGEMENT.

BY WILLIAM S. COZAD, NORFOLK & WESTERN RAILWAY.

IV.

(*Concluded from page* 58.)

The filing case is divided into small sections, the number of each section corresponding to the number of the man whose card is placed in it. On the right will be noticed boxes numbered 100, 200, etc.; these boxes serve as a temporary file. Piece-work cards from 1 to 100, after being entered in the time book, should be placed in box 100, cards from 101 to 200 in box 200, and so on. In small shops these boxes may be numbered from 1 to 50, etc., if desired. Fig. 9 represents a front view of this Card Record case. This case should be made with doors and of sufficient size to accommodate the shop, or department, each man's number to correspond to one number in the case.



Front view of card record case.
FIG. 9.

One of the claims made for this system of time-keeping is that each workman entering the shop *must* be accounted for. If he does not see that he is registered, he alone is responsible if he loses his time. It also precludes the possibility of allowing an employee time when he is not in the shop, or of failing to allow him time when he is at work, except on account of clerical error. It may be claimed that it is taking an unreasonable view of the matter to suppose that errors of such a nature will occur, but a number of such instances have come to the personal knowledge of the writer; in one case a car repairer was carried on the time book an entire month, his time was put on the pay-roll and a check made for it, when he was not inside the shop-yard gate at any time within the month. This was in a department of a shop employing several hundred men, where the foreman was stock clerk, shipping clerk, time-keeper, and about everything else, except foreman. Experience has proven very clearly that unless specific methods are followed, it is a very easy matter to over-pay or under-pay for half days, or a number of hours, and often very difficult to locate the responsibility for the error.

The brass check system, used in many shops for registering men in and out, is practically no check at all, as checks may be lost, "sent in," left hanging on the board, etc., etc. Many railway shops have no system at all of checking men, either in or out. In a shop in which the writer was employed sometime ago, where several hundred men were at work and where no system of checking was used, employees could be seen coming in at any time up to 8 A. M. and leaving at any time between 5 and 6 P. M. This is demoralizing to the men, and if the boys, who are taken in as apprentices, come up under this condition, to be careless, indifferent men, the officials of the shop are directly responsible for it.

The system described above will be found suitable for any department of a railway shop, either car or locomotive, and if put into the hands of a competent time-keeper and competent piece-work inspectors, it will be found that the occurrence of such instances as outlined will be entirely avoided, and that with the assistance of the piece-work inspectors at the end of the month, one man will be able to handle the time of a large number of employees.

It is not claimed, of course, that this system is entirely perfect, but it is believed that when properly handled it will meet all practical requirements. The writer invites criticism, and will be very glad to attempt to answer the inquiries of any one interested in the subject.

CONCLUSION.

APPRENTICES UNDER PIECEWORK.

Within the past half dozen years many papers have been written on the subject of handling apprentices, not only in repair shops, but in the large iron and steel manufacturing concerns of the country; the effect of this seems to have been not to establish a set of rules which might be followed by all large shops, but to fix more firmly in the mind of the shop superintendent the belief that the methods, which have been in effect for many years past, are sufficient, if properly applied, to meet all necessary requirements.

While all this *general* discussion has been going on, very little, if anything, has been said in relation to handling apprentices in railway repair shops operated on a piece-work basis—as to whether they should be allowed to work piece-work in the blacksmith shop, machine shop, boiler shop, etc., and if so, to what extent, or whether there should be any limit. To discuss this subject intelligently it is necessary to examine certain phases of the question on which the successful application of the piece-work principle must rest, chief of which is the present rate of wages now paid apprentices in railroad shops.

The employment and training of apprentices was a subject of special investigation and discussion before the American Railway Master Mechanics' Association for some three or four years, and on the wage question the following recommendation was made: "Your committee would suggest, as an equitable scale of pay, 50 cents a day for a 10-hour day; that is, 50 cents for the first year and an increase of 25 cents a day for each year thereafter, and for an 8-hour day, 40 cents a day for the first year and an increase of 20 cents per day for each year thereafter."

Since this recommendation was made a great many men, prominent in the motive power department, have written on the subject of training apprentices, some expressing one opinion, some another; but no one has been willing to defend the extremely low scale of wages proposed in the above report (and few roads are paying as little), while many have expressed themselves as believing it to be entirely too low.

We cannot sustain present low wages on the ground that not many years ago boys were glad of an opportunity to learn a trade without any compensation whatever. Times and condi-

tions change. Wages have doubled, and in many instances, are three times what they were a few years ago. Men have advanced in knowledge, are more capable, and the boys who are now put on their time are more intelligent and better qualified for the work before them. They are required to produce more and better work than ever before and there can be nothing more unreasonable than to expect a sober, honest, industrious young man 22 or 23 years of age (24 is the limit) to go into a boiler shop and perform the hardest kind of manual labor for 10 long hours for the very small sum of 50 cents.

A young man, perhaps 18 years of age, is placed in the blacksmith shop as an apprentice. After he has run the steam hammer or a bolt machine for a few months he is put on some heavy work, where he is expected to swing a 10-pound sledge six days in the week, and when Saturday night comes he is obliged to send home for a dollar to make enough to pay his board bill for the week. This furnishes ample reason for the fact that the number of young men applying for positions in the boiler and blacksmith shops are comparatively few.

The helper enters the shop and is paid from the first at the rate of about $1.50 per day for his services; and, while there is no special course laid out for him, if he is intelligent, "keeps his eye on the gun" and attends strictly to his business, he can, at the end of the first two or three years, resign his position, go to some other shop where he is not known and *hire out as a full-fledged mechanic*—and after working three or six months, return to his home shop, and, from that time on, he is a *finished mechanic* and receives all the recognition and wages which belong to his profession. The apprentice whom he left six months ago may now be put with him under instruction and has a year to serve at $1.50 per day or less before he can be considered as well qualified in the profession as his present instructor, who was advanced from sweeper to helper a month after he (the apprentice) was put on his time.

A question is suggested here which ought to receive the sober consideration of all laboring men as well as employers of labor who operate the shops in question: that is, when the foreman finds that he has a young man in his shop who is in every way qualified to do certain lines of mechanical work it ought to be in full accord with the natural order of things to recognize his ability. It doesn't make half so much difference who a man's father was as who his son is, or where a man came from as which way he is going; and after all, the most essential requirement is not a certain number of years apprenticeship, but *ability to perform the service required.* Having character and a good reputation, then, the standard by which human usefulness must be measured is capacity to meet the practical requirements of the department in which we are employed.

Next in order, is apprentices working with mechanics on piece-work jobs. It has been recommended by a committee of the American Railway Master Mechanics' Association that "Apprentices who are working with mechanics on piece-work jobs will be paid their regular hourly rates. Mechanics thus assisted by apprentices on piece-work jobs will be paid only the proper proportion of the piece-work rate."

If a sweeper is taken from the floor to assist in handling a set of steam pipes where piece-work prices prevail, he is usually put on the card with the mechanic and the total amount of the job is divided in proportion to the day rate and the number of hours worked. If a handy man strips an engine, rods, ash pan, boiler mounting, motion work, etc., he receives the prevailing piece-work price of the shop for his service. If a helper assists a mechanic in putting in a set of pistons or hanging a set of guides, he is paid either his proportion as based on day rate or a certain fixed per cent of the total amount earned. This is all right. If, however, an apprentice performs any of the work outlined above—no matter how quickly and how well—he is to be paid according to the above ruling—not what he earns, but "his regular hourly rate."

Why this difference? Why is not the product of the apprentice worth as much to the company as the product of the sweeper or the helper? The only argument in favor of this policy is that piece-work encourages poor work and a desire on the part of the workman to get through as quickly as possible, regardless of the quality of the work. This condition, if it exist at all, is due entirely to improper shop supervision. Such a method is not only wrong in principle, but discouraging to the average young man who would like to make a record, but whose mind is continually absorbed in trying to solve the impossible problem of making a $1 bill pay a $2 debt. It places a premium on indolence! It leads to killing time, working without energy, lounging, hiding when the foreman passes through the shop, talking nonsense, half doing things, and a hundred other things, all of which instead of stimulating the worker to more earnest efforts, lead him to believe that his principal duty lies in putting in 8 or 10 hours a day, no matter how it is done!

It has also been recommended that "The charge of apprentices should be given to one particular and well qualified person, to be known as the foreman of apprentices. This practice is followed in other countries and is undoubtedly satisfactory. We know of no other way of insuring the proper attention being given apprentices without great waste of somebody's time. One person should be distinctly charged with the care of apprentices and should be responsible for them, and much pains should be taken in the selection of the man."

This is the keynote to the entire situation. It will solve the problem in any shop, either large or small, not only from the standpoint of economy on the side of the company, but also in satisfying the desire of the ambitious boy to find the quickest and best way to do things. It will also insure a much higher grade of mechanics in the future. Whether there should be a man assigned to each department to instruct apprentices, or whether one man for the entire shop, to be known as foreman of all apprentices, is a question which could probably best be settled by each individual shop, depending somewhat on the size of the plant. But the recommendation that "much pains should be taken in the selection of the man" is strictly to the point. We believe that the man selected should not only have some technical ability, but should be a mechanic who has had a wide experience in his profession and *knows his business.* He should be a reader and an investigator, as well as a worker in the shop. He should go from one machine to another, study his young men individually, find out their weak points and build them up.

A book account ought to be opened with each apprentice the first day he enters the shop. He should know that he begins work with nothing in his favor and nothing against him, and that his future record with the company is going to be couched in an impartial double entry account. If he comes in late in the mornings, wastes time, is negligent, careless in the use of his tools, spoils work, or is continually complaining about "everything bein' out o' fix," it will be recorded against him, and if, after he has been employed a sufficient time, it is the judgment of the management that he is not fitted for the work before him, he will be dropped from the service. If, on the other hand, he is always on time, attentive, energetic, devotes his spare time to study, and is always making a special effort to improve on his past record, all these facts will be recorded in his favor. The old way of the foreman going up to an apprentice and saying: "Well, Mike, you did fair work on that last job, except it's a little rough, now see if you can't do better next time"; or, if Mike has gone wrong, of flaying him with language more forcible than elegant and threatening to discharge him right on the spot if it ever happens again, ought to be abolished and a record in fact kept; and on that record should hang the young man's future success with the company.

Now as to apprentices working piece-work: It can be demonstrated beyond any possible question, as the following illustrations will show, that by giving apprentices a piece-rating, their interests in the work will be quickened, their energy aroused in the work, and they will very materially increase their earnings over the day rate, while at the same time the cost of output will be very largely decreased to the company.

In the code of rules covering the time of apprentices in the blacksmith shop as laid down by the American Railway Master

Mechanics' Association, the first six months shall be spent on the bolt heading machine or steam hammer. Very good—let us consider an example:

Let A represent a foreman of a shop in which piece-work has been reduced to an exact science. Everything is alive with energy, the foreman being always in the lead. His piece-work rate for heading bolts is $1 per thousand. He has an apprentice working on the bolt heading machine, who was formerly rated at 75 cents per day on day work, the helper having been rated at $1.25 per day on day work. The average output of an ordinary Ajax or Acme bolt machine, run in connection with proper heating facilities, is about 4,000 bolts, ⅞-in. diameter and under, per day. The machine in this shop being run up to its normal capacity, the apprentice and helper on the work make $2 each per day and the bolts cost the company $1 per thousand, as stated above.

B is a foreman running another shop. He believes in standards. He pays his apprentices 50 cents per day and helpers $1.25. He has no foreman of apprentices; never could see the use of so much supervision. They tried piece-work one time, but found it to be a failure. The foreman allows that two men attending strictly to business ought to head about 1,800 bolts in 10 hours. Here he is a little ahead of the procession, for this is a high average in day work shops, although there are some exceptions. At this rate it would take 22 hours to make 4,000 bolts, and they would cost for labor $3.85. The cost of the machine for the extra 12 hours, which is required by this method to make the bolts, being figured at 35 cents per hour, is $4.20; this makes the total cost of the 4,000 bolts, $8.05, or $2.01 per thousand. Hence it will be readily seen that A, by the systematic organization of his work and proper appreciation of the service of his employees, has not only doubled the wages of his men, but reduced by one-half the cost of the product to the company.

Let us take another example: A is foreman of a machine shop. His apprentices are rated at 50 cents per day, first year, but everything is on a piece-work basis. His machines are all in good repair, and on the bolt lathes he has a special chuck which takes the bolt without stopping the machine. He has an apprentice running one of these bolt lathes who just commenced a week ago and pays him ½ cent each for roughing out bolts 8 to 12 ins. long, 1-in. diameter. He has been thoroughly instructed in the work by the foreman of apprentices. The lathe is run at the rate of about 175 revs. per min., or at a cutting speed of about 50 ft. per min., easily rough-turning 30 bolts of the above dimensions per hour, or 200 per day, which, at ¾ cent each, makes the day's earnings $1.50.

B is foreman of another shop, all on day work. Apprentices are paid 50 cents per day, first year. No particular attention is paid to them. John Smith, a boy 17 years of age, commenced work a week ago, was taken over and introduced to an old rickety lathe, and has not spoken to the foreman since. He found the belt in a certain position on the cone, and has been afraid to attempt to change it. The lathe is running about 75 revs. per min., but it looks to him as though it is running 500 revs. He tried the first two or three days to do something but did not make much headway. Nobody seemed to pay much attention to anything but the clock and the whistle, and he concludes that he is doing well enough and settles down to that pace. An inventory of his stock at the end of the day discloses the remarkable fact that he has rough-turned 50 bolts of 1-in. diameter and 12 ins. long.

To turn 200 bolts at this rate would require four days at 50 cents per day or $2 cost. Now, figuring that the machine is worth $1 a day to the company, we would get the use of it three days more by the first method, which would amount to $3, making the total cost of 200 bolts by the day-work standard, $5, or $2.50 per 100, as against 50 cents per hundred under the piece-rate plan. In the first instance, the boy increased his day rate 200 per cent. and the company saved even more, while in the last example both lost in the end.

The above illustrations are not visionary, but will be recognized as plain, common sense facts by all who have had an opportunity to study the practical effect of both methods. Many other similar cases might be cited, but these two are sufficient to show the general trend of the apprentice who is given little or no attention, and the consequent loss to the company.

To the young man serving his time who, perchance, may read this article, I beg to add a parting word. *Don't be afraid of earning a dollar more than you get!* If you are paid $1 per day, and earn no more, you are a dead weight on the company's hands. Business institutions are not run for amusement, but for profit; and the man who does not add his mite to the sum total of the profits is in the wrong business. Remember, too, you are in business for yourself and cannot afford to waste a minute.

If you do not receive such attention as you may wish for, work out your own salvation. Think! investigate! experiment! If you don't succeed by one means, try another. There is no such thing as failure before the man with an iron will. Once in the service of the company on your time, with your name on the pay-roll, no matter what kind of a shop, you have the advantage of a thousand less fortunate boys and you ought to succeed. But no matter where you go, nor in what shop you work, if you are quick, active, earnest and energetic, you will find men eager to advise you: not to hurry, to take lots of time, that the world wasn't built in a day, not to spoil the job by doing so much, that the company will cut the price, that the next man will have to do more than you, etc., etc., and this from genuine "knockers" full of whimsical inconsistency and perverse unreason—"knockers" who were born wrong, and are "knockers" because they were born wrong. They seem to have wheels in their head that are continually running in the wrong direction. But let me insist for your own good, that you:

"Go ahead and make your play,
Never mind the knocker.
He's in every worker's way,
Never mind the knocker."

"He strikes only those who climb;
Never mind the knocker.
'Tis success he deems a crime,
Never mind the knocker."

"When the knocker's course is run,
When his jeers and scoffs are done,
He'll be cursed by every one;
Never mind the knocker."

(The above lines are quoted from the *Machinists' Journal.*)

A little while ago a motive power superintendent sat up nights preparing a lecture to be delivered to the apprentices of one of his shops. The shop men heard of this and asked to be allowed to come in. When the apprentices assembled, two hundred shop men came with them, and all listened with interested attention to a most admirable address from a man who had worn overalls for years and knew what he was talking about when he revealed to his audience a view of the ground upon which the mechanic of to-day stands, as they could not possibly have seen it before. He traced the development of machine tools and the men who created them, and showed the effect of the progress of the times upon the demand for highly skillful workmen. The shops of this country are full of men who are ready with instant and generous response to official superiors who fully understand the relations between those who direct and those who do the work—next day the life of the tool dresser in that shop was made miserable and he quit to give place to a better one who could give the men the tools they wanted.

Mr. George W. Wildin has resigned as mechanical engineer of the Central Railroad of New Jersey, to accept the appointment of assistant mechanical superintendent of the Erie Railroad, with headquarters at Meadville, Pa.

CONVERSION OF LOCOMOTIVES.

BY G. R. HENDERSON.

Most large railroads of the present day are composed of an aggregation of small roads, having a heterogeneous assortment of equipment of various ages and capabilities. The selection of these engines may not in all cases have been wisely made, and the changing conditions of traffic will in a few years sometimes demand an entirely different class of power.

The principal weakness of the older engines lies in their meager heating surface, as this feature has been given the greatest attention in recent years; and the strenuous manner in which engines are operated at the present time calls for all the heating surface which can be provided, even in modern locomotives. Under these conditions the superintendent of motive power is at times put to his wits' end in an effort to obtain some kind of satisfactory service from the old power. As switch engines seldom are required to generate large quantities of steam continuously, if the size of the drivers and other parts permit, the engines may be used in switching service. Generally, however, the wheel base is excessive and changes are desirable in order to make a satisfactory locomotive for this purpose.

One of our large Western roads owns a number of consolidation locomotives with 17 x 26-in. cylinders, drivers from 45 to 48 ins. over the tire, and boilers carrying from 130 to 150 lbs. steam. The adhesive weight is only about 70,000 lbs. and the heating surface from 1,000 to 1,100 sq. ft., the engines being over twenty years old. It is evident that these are not fit for economical road service, but will answer fairly well for switching. Unfortunately, the cylinders of these engines have so much overhang and the back of the engines so little that it is hardly practicable to remove the truck, and besides the limited tractive force of these engines, about 18,000 lbs., renders them inadequate to handle trains brought in by the new heavy road engines. The great need for switch engines of suitable power was partly met by changing some much larger consolidation engines, as explained below. These were originally tandem compounds, having 15 and 25 x 28-in. cylinders, 57-in. wheels, and carrying 180 lbs. boiler pressure, with 150,000 lbs. adhesive weight. The heating surface, 1,900 sq. ft., was rather small for road service, but ample for yard use. In converting these engines, the front truck was removed, as were also the high-pressure cylinders, and the smokebox and front frames were shortened, the low-pressure cylinders being bushed to 22 ins., thereby converting them to simple engines. The removal of the truck reduced the wheel base from 23 ft. 9½ ins. to 15 ft. 2 ins., the distribution of weight showing 42,500, 42,800, 35,800 and 33,800 on the first, second, third and rear pair of drivers respectively, the tractive force amounting to 31,100 lbs. When fitted with the Westinghouse straight-air cock in connection with the ordinary automatic fixtures, these engines gave the best of service, as they were able to handle complete trains brought in by the road locomotives, and the boiler was amply large for this service. As the engines are only four years old, they will be useful for many years to come.

The same road owned in its equipment ten passenger locomotives of the ten-wheel type. These engines have 20 x 26-in. cylinders, 73-in. drivers, 180 lbs. steam pressure, with 123,000 lbs. adhesive weight. The heating surface, however, amounted to but 2,150 sq. ft. and the grate area to 28½ sq. ft. These engines were only three years old, but, as may be imagined from the grate and heating surface quoted, they were always regarded as poor steamers. Modern locomotives of this size would have at least 45 sq. ft. of grate and 3,000 sq. ft. of heating surface. As these machines were comparatively new, it would not be wise to retire them, and a study was made to determine what could best be done with them. The tractive force being only about 20,000 lbs. and the adhesive weight more than six times as much, it was decided that the engines could best be converted into the Atlantic or 4—4—2 type, which would permit the use of wide firebox boilers. A boiler of 68 ins. diameter was therefore designed in place of the old 60-in. shell. It had 49 sq. ft. of grate and 3,100 sq. ft. of heating surface, the working pressure being 200 lbs., as after examination it was believed that the machinery would safely stand this 20-lb. increase and that the larger and heavier boiler would still prevent slipping with two pairs of drivers instead of three pairs. The main frames were cut back of the main pedestals and a low trailing pedestal welded on, the trailers being 42 ins. in diameter. The rear section of the side rods were omitted and the knuckle-pin ends cut from the front sections. No changes were made in the cylinders or valve motion, the front of the engine remaining as originally constructed, except the smokebox, which was enlarged to suit the boiler. The expected weight on drivers after this change was figured at 93,000 lbs. and the tractive force at 22,000 lbs. The old boilers, being comparatively new, were to be used in stationary work and were to be credited to the engines. It was thought that the cost of making the change would amount to $4,000 per engine. None of these engines has yet been put into service after being altered, but the work on the first one is well under way.

Of course, it does not follow that every ten-wheel engine could be so converted, but in the case quoted the engine was under-cylindered for the adhesive weight, and "under-boilered" for the cylinders. Ordinarily the removal of one pair of drivers would produce too slippery an engine; but in the present case there was an excess of adhesive weight. This machine as changed will be a very close counterpart of the Class D engines of the Chicago & Northwestern, which have a tractive force of 20,800 lbs., with 91,000 lbs. on drivers, 20 x 26-in. cylinders, 80-in. wheels and 46 sq. ft. grate area, with 3,015 sq. ft. of heating surface. (See AMERICAN ENGINEER, August, 1900.)

The welfare of the ordinary shop apprentice is engaging the attention of an increasing number of able mechanical railroad officers. They see the necessity for returning to the degree of care with which boys used to be educated in shops years ago and are insisting that the foremen interest themselves in the boys and see that they have an opportunity to properly learn shop work. They are personally supervising apprenticeship, by meeting the boys occasionally and questioning them to find out what they have learned. In every way these officers are endeavoring to be honest with the apprentices and secure for them that for which they enter apprenticeship. Four of these officers brought up the subject, on a recent trip of one of our staff, and spoke of apprenticeship as the only means for securing high grade men for shop forces in the future. They all mentioned the desirability of providing night schools or encouraging the boys to attend schools already available, in order to start them in elementary mechanics and mechanical drawing. Two of them are actually supporting night drawing schools out of their own pockets and are enthusiastic as to the results. They are somewhat discouraged by the fact that they are educating boys for service on other roads and are hopeful that such efforts will soon become sufficiently general to overcome this difficulty. This journal heartily commends such efforts and would exert its influence in every possible way to show the vital need of uplifting apprenticeship against all indifference and opposition on the part of those who do not appreciate it and selfishly desire to continue, as at present. Labor organizations are, as a rule, not helpful in their attitude toward apprenticeship or toward the boy who has completed his term and is ready to enter the ranks of journeymen. This, however, is believed to be but a temporary obstacle. On a large railroad system it ought to be easy to send a young journeyman to another shop—starting him in new surroundings, not those in which he lived as a student—and thus retain his services.

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Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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CONTENTS.

After a most profitable and thoroughly enjoyable trip to Great Britain and Continental Europe, I return greatly improved in health and with a heart full of gratitude for the friends who made the journey possible. Observations and impressions resulting from meeting many men who are carrying the burden of transportation problems abroad are being presented in a series of letters, appearing in these pages, in the hope of suggesting some new ways of viewing our own problems which may perhaps prove helpful in their solution.

I wish that all of the friends could have been with me to share the universally cordial receptions, enjoy the pleasures of the journey and to aid in drawing conclusions from it. My conclusions are matters of individual opinion, but they are carefully presented. Of one thing I am more than ever sure: That of all problems vitally touching human interests, there are none more important than those concerning transportation. What I have seen and learned abroad increases my respect and admiration for the accomplishments of American railroad motive power men, who are confronted by difficulties which are unknown elsewhere.

I take this occasion to express my hearty thanks to the European railroad officials for the courteous, cordial and kind reception which they gave me everywhere on this trip. To my friends who sent me abroad, I add another word of heartfelt gratitude for their kindness to me. G. M. BASFORD.

"Engine failures" are the bane of transportation as well as mechanical departments. They are increasing rather than decreasing. This is because of the heavy work locomotives are called upon to do which they never faced before "large train tonnage" became a watchword. Operating officers complain that they cannot get the service from locomotives which they used to get, and they are likely to criticise modern tendencies in design, thinking that these are responsible for failures and for the delays in turning engines at terminals. They forget that locomotives cannot be forced without paying the price, particularly with respect to firebox repairs. An "engine failure" is nowadays usually a firebox failure, from leaky tubes or seams, caused by the forcing of the fire. The fires should and must be forced, but there is a point where it becomes more economical to lighten the load rather than put the locomotive in the hands of the boilermaker after every trip in order that it may be put in shape for the next one.

The writer recently took a photograph of a gang of thirteen men engaged, with the help of a rope tackle, in moving a plate of firebox steel from the storehouse to the boiler shop of a well-known railroad. Now, "13" is an unlucky number, and therefore the picture will not be printed. It is also an unlucky number for that railroad. Even if facilities for handling such material are not provided, there are ways of moving it which are quicker and less expensive than this. It is strange that the value of investments in appliances for handling material is so often overlooked. Overhead trolleys and air hoists are cheap and may be made at home. In the absence of power cranes they may be made exceedingly useful.

Nowhere are hoisting facilities more needed than in roundhouses where large or small engines are cared for. In a certain trip of over 7,000 miles, recently made by the writer, not one roundhouse was found which had anything of this kind.

Draft gear of passenger equipment needs immediate attention. The construction of 10 or 15 years ago, when locomotives and cars were light, and trains had comparatively few cars, will not answer now, when passenger locomotives of 30,000 lbs. tractive effort and Pullman cars weighing 125,000 lbs are in common use. When they start heavy trains these big locomotives "bottom" the present draft gears, and a sudden pull of moderate severity may, and often does, pull out the draft gear, break a coupler or a knuckle. The draft springs should have a greater capacity than from 12,000 to 16,000 lbs., and the attachments should be made correspondingly stronger. It is claimed

that many of the break-in-twos of the present time are in the couplers and knuckles, and that these should not be laid to the draft gear itself. This is not fair to the coupler, because when a spring "bottoms" something must yield, and the weakest part gives way. Passenger draft gear needs to be brought up to the capacity of present big locomotives, and the best way to accomplish this seems to be the adoption of the friction principle. This is now being applied to a number of officers' cars. A better test would be had on baggage cars, which are always at the head end of a train.

Ash-pit work is the slowest process about most roundhouses. Boiler washing causes considerable delay, but it does not stand out as prominently as work which must be done at each end of every run. It is evident that more ash-pit tracks should be provided, and many complaints are heard because of the failure to provide more than one pit track for terminals where from 25 to 75 locomotives per day must be dealt with. In one instance eight locomotives were found, by a representative of this journal, awaiting their turn for attention from the fire cleaners. Passenger and freight engines were mixed as they came, and in the midst of the rush the ash pit was found to be full from the accumulation of the morning, and all progress stopped until it was cleaned out enough to provide for these engines. The superintendent of motive power expressed the serious need of two things: three or four ash-pit tracks with pits long enough to take a full day's accumulation, and improved locomotive grate construction which would permit of cleaning fires quickly. These would greatly facilitate movement of locomotives, and they would also aid in reducing the troubles with leaky tubes. This is found to be a more serious and general difficulty than ever before.

ECONOMY IN RAILROAD OPERATION.

"Railroads operate over wide expanses of territory, are directly administered by men who have no personal interest in the question of economies and who have all they can do to keep things moving. One great reason why no personal interest is felt, is, that the official in charge has no financial interests at stake, and being on a salary, may be looking for another position to-morrow. A change of management nearly always makes more or less changes in minor officials, and often a complete one in heads of departments. Such changes are occurring monthly, and but a few days ago I overheard a remark to the effect that "if Mr. X. gets to be general manager of a certain road Mr. A. would not last fifteen minutes." So it is not reasonable to expect men, under such circumstances, to lay awake nights or work overtime, trying to save dollars. If one can make a record as an active man and a hustler he is doing all that he feels is necessary, both for himself and the company."

This paragraph, quoted from a paper read by Mr. W. B. Waggoner before the Western Railway Club, represents a situation which exists too generally in the United States. Very few railroads in this country appreciate the necessity for a definite policy of operation and a steadiness of such a policy which will permit the most important officials to devote their time to the real interests of their employers. Men who are most deeply concerned in efforts to hold their jobs cannot do good work, and cannot frame long term policies with a view of attaining true economy of operation. What can be expected of an official who by frequent changes in management is kept in a continual fever of excitement for fear of losing his position? With all due respect to the advantages of occasional "new blood," the cases of taking officers from other roads to fill vacancies is becoming a serious menace, and it is time for managements to begin to think this over. One thing stands out prominently in European practice—the officials are free from these wild-eyed anxieties and are therefore in position to do their best work.

MOTOR DRIVEN MACHINE TOOLS.

Planer Driving by Electric Motors.—II.

Continuing the subject of planer driving by electric motors, we are enabled to show herewith a number of interesting arrangements of motor-application. In the previous article (pages 69 to 72 of the February issue), reference was made to an arrangement for varying the cutting speed of the machine while the return speed remained constant. The question may be asked: Why is this a desirable feature? Why cannot the return speed be varied as well as the cutting speed?

The answer is that most planers are so designed as to give a fixed cutting speed which is supposed to be suitable to about the slowest rate needed under average conditions. This minimum cutting speed is usually fixed at about 20 or 24 ft. per minute, and is accompanied by a corresponding reverse speed of from three, to three and a half times this speed, or, say, from 60 to 84 ft. per minute. These speeds will vary somewhat with the size of the planer, but they represent average practice for the majority of planers. In some cases, it has been found desirable and possible to run roughing cuts on cast iron at 30 to 40 ft., and finishing cuts at from 50 to 60 ft. per minute; also, with the use of improved steel for cutting tools, these higher cutting speeds can be used for steel as well.

Assuming a possible cutting speed of 60 ft. per minute, and a return speed of 80 or 90 ft. per minute as the limit which can be placed upon the driving mechanism, it will be evidently impracticable, if not impossible, to further increase the return speed, with the usual planer design. The variation of work upon some planers will require a range of cutting speed of from 20 to 60 ft. per minute, but it will now be seen to be quite out of the question to have a return-speed range with the same ratio; hence, the usual practice is to vary the speed only on the cutting stroke, and to make the return speed constant at as high a rate as the mechanism will stand. This is not so much due to the fact that the platen cannot be moved at a high rate of speed, if once started, but owing to the severe work at the moment of reversal and the time required to bring up the speed from the reversal point, causing a heavy strain to be thrown upon the belts and driving mechanism; there is a limit to speed, commercially as well as mechanically.

As relating to this phase of the subject of speed changing, we beg to call attention to the illustration, Fig. 9, which shows a special method of planer driving, as built by the Cincinnati Planer Company, Cincinnati, O. This machine is driven by a Northern Electric constant-speed motor, which is connected to the constant speed shaft by a chain; driving by means of a chain seems to be preferred to gears by some users. This constant speed shaft, upon which is mounted the return driving pulley, is connected through a gear box to the variable speed shaft which carries the pulley for the cutting stroke. The change gears of this mechanism are so proportioned as to give the desired rates of cutting speeds, and the changes from one speed to another is effected by means of the shaft and hand wheel shown alongside the housing of the machine.

Another method of obtaining a variable cutting speed, with constant-speed table return, is illustrated by Fig. 10, which shows a planer built by the Betts Machine Company, Wilmington, Del., with a motor drive using a Crocker-Wheeler motor. It will be seen that in this case the motor is set low, partially below the floor line. The countershaft for this machine is carried upon brackets which are attached to the housings of the planer. Upon this countershaft are placed three pulleys. The inner pulley, or the one next to the machine housing, is a cone, and has three steps; this pulley is attached to the countershaft and is driven from a similar three stepped pulley on the motor shaft.

By means of these stepped pulleys, the cutting speed can be varied to suit the work in hand. The outside pulley is also attached to the countershaft and drives the platen in the forward or cutting stroke in the usual manner. To obtain the constant return speed of the platen, a two step pulley is

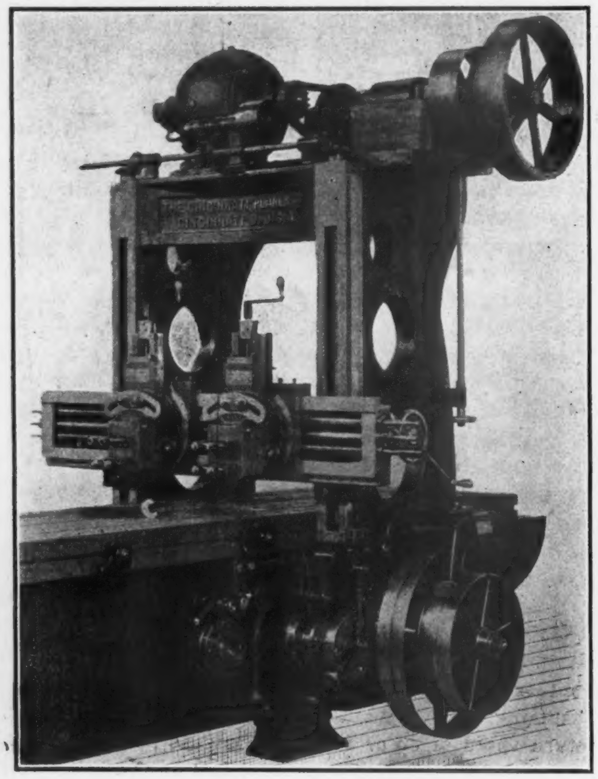


FIG. 9.—A SPECIAL DESIGN OF FLYWHEEL DRIVE UPON A PLANER, WITH MECHANICAL VARIABLE-SPEED DEVICE; BUILT BY THE CINCINNATI PLANER COMPANY.—NORTHERN ELECTRIC MOTOR.

mounted on the countershaft and runs loosely upon it; this pulley is driven by belt from another pulley on the motor shaft. By this means the return speed is kept constant and the same as the motor speed. One face of the two stepped pulley is of double width to allow for the shifting of the belt which drives the platen in return direction. This device forms quite a unique arrangement.

An interesting self-contained drive is illustrated in Fig. 11.

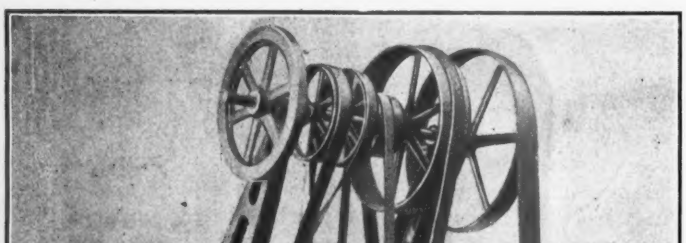


FIG. 11.—VIEW OF THE BELTED INDIVIDUAL DRIVE USED UPON LARGE SIZES OF THE OPEN-SIDE PLANERS, BUILT BY THE DETRICK & HARVEY MACHINE COMPANY, SHOWING USE OF FLYWHEEL.

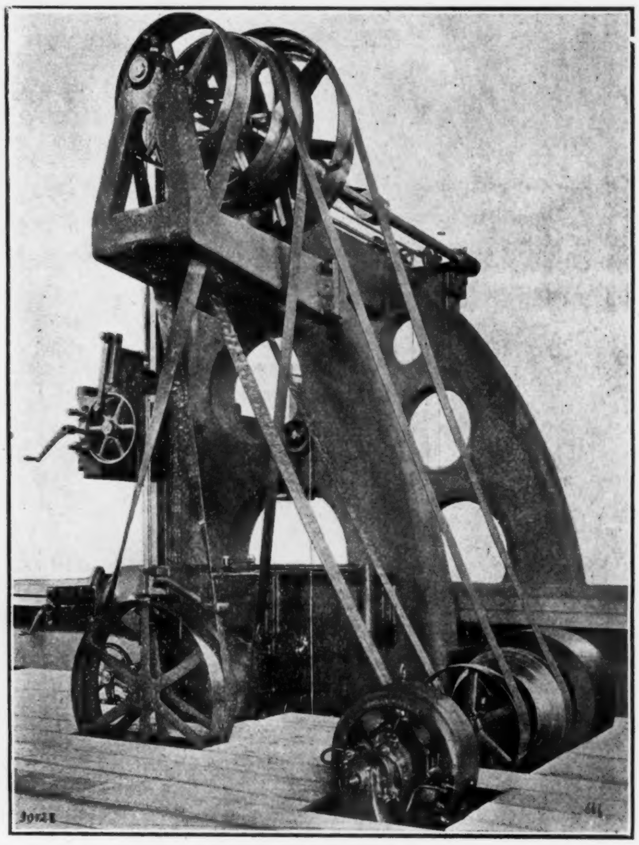


FIG. 10.—AN INTERESTING MOTOR DRIVE UPON A HEAVY BETTS PLANER, USING AN UNUSUALLY HEAVY FLYWHEEL. CROCKER-WHEELER MOTOR.

This shows a large open-side planer, built by the Detrick & Harvey Machine Company, Baltimore, Md., which is equipped for motor-driving, using the belt-drive. The countershaft of this machine is specially mounted upon standards, secured to the tops of the housings of the planer, and of such a height as to give sufficient length to the operating belts, the belts operating the raising and lowering of the cross-rail being the ones that determined this height. This makes necessary the seemingly high arrangement of shaft supports, but with this arrangement the motor can be placed in any convenient position, as is shown. In Fig. 12, which is a view of the style of

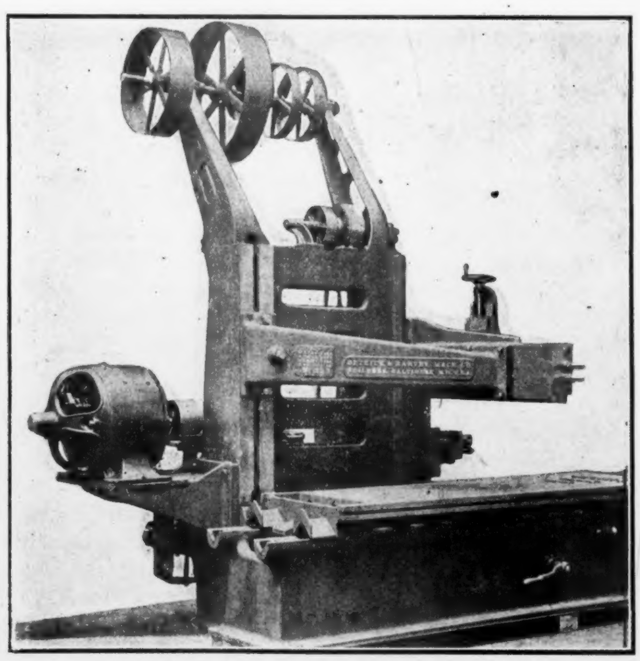


FIG. 12.—THE TYPE OF INDIVIDUAL DRIVE (BELTED) USED UPON THE SMALLER SIZES OF OPEN-SIDE PLANERS BY THE DETRICK & HARVEY MACHINE COMPANY.—GENERAL ELECTRIC MOTOR.

motor application used by the Detrick & Harvey Machine Company upon their smaller sizes of open side planers, the flexibility of this arrangement may be seen; here the motor, a General Electric constant-sped motor, is mounted upon a small bracket on the end of the frame of the tool. Upon the larger tool a very heavy flywheel is shown on the countershaft; the flywheel is used on the smaller size of the Detrick & Harvey planers, but this tool is shown without the same in place.

So far, the machines described above have been examples of motor drive wherein the necessary changes from the standard form of belt drive have been made at the works where the machines were built. When such changes can be thus made upon new machines, the whole design can be made to present a more or less harmonious design as to appearance and utility. When, however, an existing machine must be changed from belt to motor drive, the conditions are different, and call for different treatment.

Fig. 14 is an illustration of such a case. The cut shows a planer built by the Putnam Machine Company, Fitchburg, Mass. The arrangement here used for carrying the motor is built up of structural shapes; the construction of which will be readily understood by reference to the view. A pair of brackets are bolted to the housings which support the I beams upon which the motor rests. The motor shaft is extended and

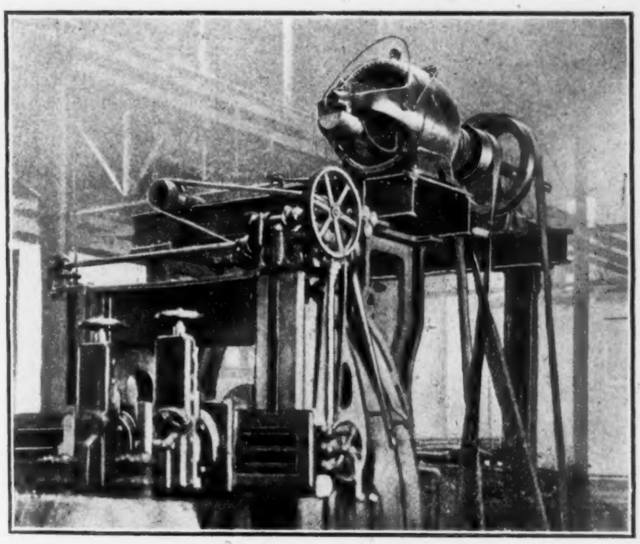


FIG. 13.—AN INTERESTING APPLICATION OF INDIVIDUAL MOTOR DRIVING, WITH FLYWHEEL, TO A PUTNAM PLANER.

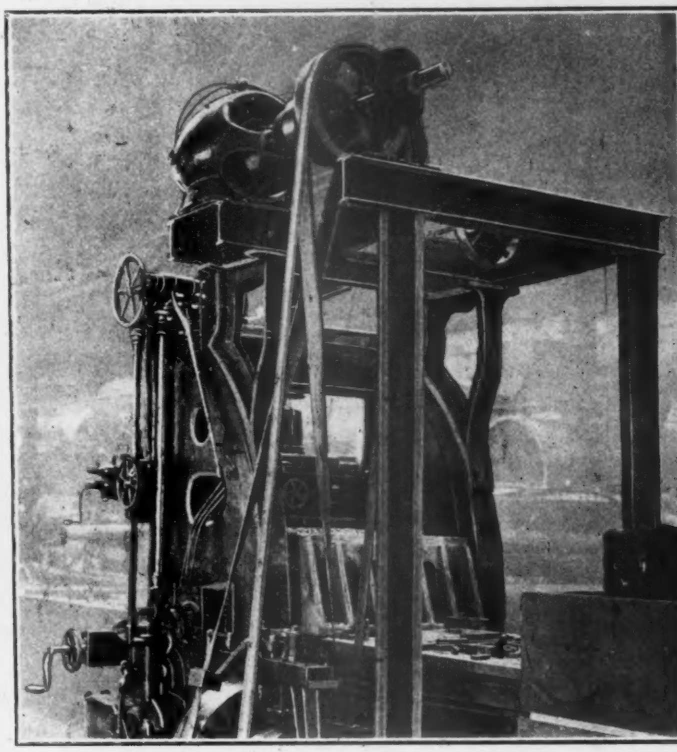


FIG. 14.—REAR VIEW OF THE MOTOR-DRIVEN PUTNAM PLANER, SHOWING STRUCTURAL SUPPORT FOR DRIVE.—MILWAUKEE MOTOR.

MOTOR-DRIVEN PLANERS.—WEST MILWAUKEE SHOPS, C. M. & ST. P. RY.

carries the pulleys for operating the machine. The bearing for the outer end of the motor shaft is carried also by an I beam which is supported by similar construction extending to the floor. This arrangement, while not as pleasing in appearance as some others perhaps, is well adapted to the existing conditions. The fact that the machine had a right angle drive, also, made it difficult to design a more compact arrangement.

In our previous article upon this subject, mention was made of some of the conditions of planer operation which required at certain times an accession of power for a brief period, and that this additional power was usually furnished by a balance wheel placed upon the motor shaft, or upon the countershaft of the machine. While there seems to be an opinion held by some that a balance wheel is superfluous, and while it may be conceded that in some cases, where the driving mechanism is of the slow-moving type, that a sufficient amount of energy is furnished by heavy countershaft pulleys, there are, however, many cases where this demand for extra power is quite urgent. A comparison of observations from a machine without a balance wheel, and one with it, will convince any one of this fact.

An examination of the illustrations of the machines described in these articles will show that the various builders have made provision for this stored energy either by extra heavy pulleys, or by separate balance wheels, as seemed most advisable. The testimony of the Betts Machine Company is to the effect that upon motor driven planers it has been their practice to provide stored energy by means of flywheels to an amount equal to about one-half of the work required by the machine, allowing the balance to come upon the motor. Experimentally, they had gone through the problem, beginning with a very heavy wheel and cutting down until the right result was reached. It was found that a too heavy wheel caused undue slippage of the belts between the countershaft and the machine. When the proper porportion was found the operation became satisfactory and vexatious troubles disappeared.

The experience of another builder is given to show the opposite method of procedure. Their first motor driven machine was sent out with a balance wheel that proved to be too light. The operation of the machine was not at all satisfactory, and the light wheel was replaced with a heavier one, and later by a still heavier one, which proved to be about what was needed.

In many cases a motor driven planer, if equipped with a properly proportioned balance wheel, will require a somewhat smaller motor than one not so equipped, and will do more work —this is the testimony of a successful builder.

In the large majority of cases a balance wheel in connection with a planer driving mechanism, is a benefit and especially so when the machine is motor driven. Just what amount of extra power is required, and the best way of applying it must be determined by existing conditions. So much difference in details of design exists between different builders, that what would apply to one will not apply to another. Numerous schemes and devices have been suggested, to improve the action of a planer as to its driving mechanism, but as yet no arrangement has been sufficiently successful to replace the ordinary countershaft, with shifting belts, with a properly arranged balance wheel effect.

Because of a rather large number of cracked cylinders in large locomotives recently built, a great hue and cry is raised on several railroads against large engines. Of course cylinders should be designed and made so that they will not break, but the very large number of old and small engines with their cylinders banded seem to have been forgotten. The trouble may be remedied without going backward as to the size of locomotives.

THE 42,000-GALLON PLANTS AT (1) STOBO, PA.; (2) NEW CASTLE JUNCTION, PA.; (3) HAZLETON, O.; (4) ROCK POINT, PA., AND (5) GROVETON, PA.
THE 21,000-GALLON PLANTS AT (6) WILLIAMSBURG, PA.; (7) WHITSETT JUNCTION, PA., AND (8) BUENA VISTA, PA.

VIEWS OF REPRESENTATIVE INSTALLATIONS OF THE WATER-SOFTENING SYSTEM.—PITTSBURG & LAKE ERIE RAILROAD.

AN EXTENSIVE WATER-SOFTENING INSTALLATION.

TOTAL CAPACITY, 348,000 GALS. PER HOUR.

PITTSBURGH & LAKE ERIE RAILROAD.

V.

As stated in the first article of this series, ten water-softening plants were provided for upon the Pittsburgh & Lake Erie, all of which are now completed and have been placed in operation. We are fortunate in being able to secure photographs of several of the other more important installations, which are herewith presented.

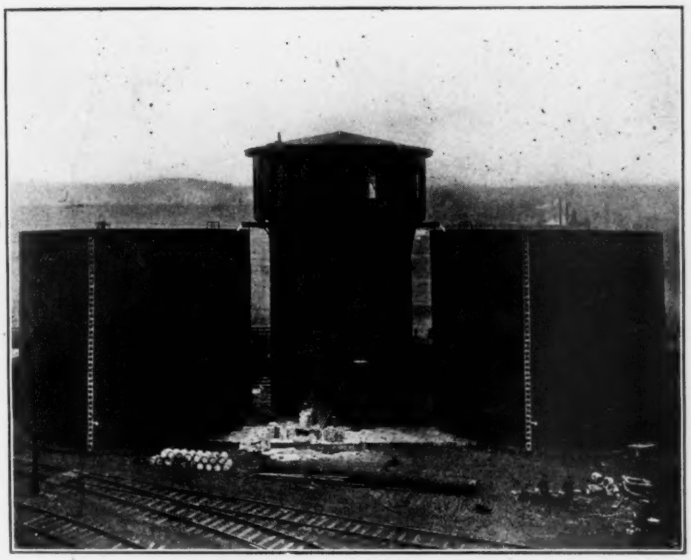


FIG. 9.—RECENT VIEW OF THE M'KEES ROCKS SOFTENER, SHOWING PROTECTING HOUSING IN PLACE.

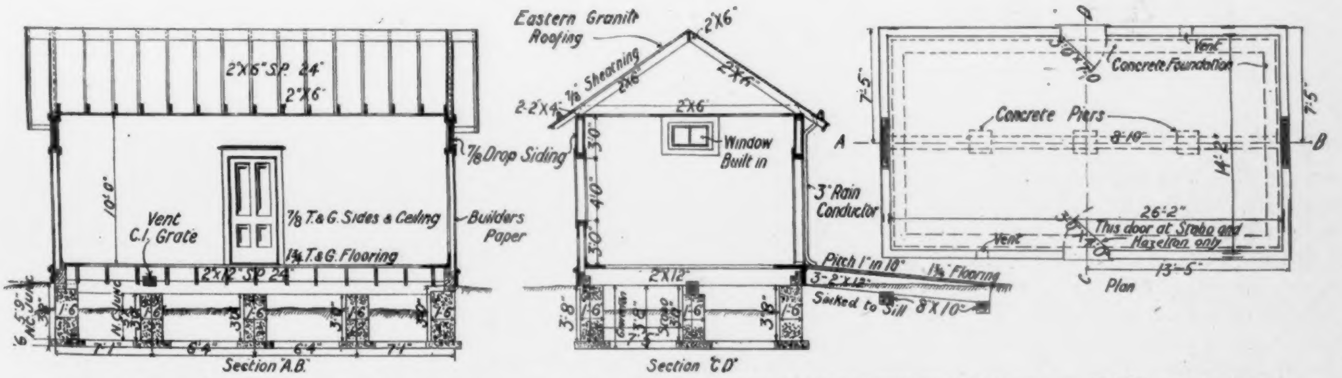
The accompanying views present representative types of the Kennicott water-softener which are in use upon this road. The softeners here shown are of smaller sizes than the McKees Rocks softener, which was described in the previous article; the capacities embraced in these installations are 21,000 and 42,000 gals. per hour. These softeners are located at the important water supply stations along the road where water is taken in sufficient quantities to warrant their installation.

All of the softeners illustrated in the accompanying engravings are of the same design, differing only from that used at McKees Rocks in size. Reference was made in the last article to the smaller sizes of softeners, which are referred to in this article. In some instances mechanical details of construction will be found to differ slightly, but the principle of operation is identical in all of the softeners in use upon this road.

The storage tanks for the treated water, however, differ widely in construction at different points. At some stations the elevated wooden tanks, of the usual type, have been continued in use, although in several other places steel storage tanks are to be found. The different types of storage tanks which are used may be seen by reference to the accompanying views. In Figs. 1, 2, 3 and 4 steel tanks will be noticed, while in Figs. 5 to 8 wooden tanks are to be found.

In the installation shown in Fig. 1, which is the one at Stobo, Pa., both the softener and the storage tank are located on the hill side, which brings their foundations at 21 ft. above the rail level. This gives an ample head for the delivery of water into the locomotive tenders, and no water is uselessly pocketed in the bottom of the storage tank, as is the case when the storage tank extends down to the rail level. The above arrangement is practically duplicated at the Rock Point (Pa.) installation, which is illustrated in Fig. 4. In the latter case also the tank foundations are located at a height of 21 ft. above the rail level. Both of the softeners above referred to have capacities of 42,000 gals. per hour, and are provided with storage tanks of 250,000 gals. capacity. Each receives its water supply from pumps driven by gasoline engines, thus minimizing the amount of attendance required; at each of these plants, one man does all the work of pumping and attending to the water purifying process, and no extra help is required on account of purifying the water.

The softener illustrated in Fig. 2, which is located at New Castle Junction, Pa., is interesting on account of its unusual height. The tops of the tanks are 77 ft. above the foundations. This was occasioned by the fact that the softener and storage tank are located at a much lower level than the track, it being necessary, of course, to have the storage tank of sufficient height to produce ample head for delivery of water into the locomotive tenders; the softener was, necessarily, made of similar height in order to deliver into the storage tank. It is obvious that all of the water in this storage tank below the level of the water plug is unavailable for delivery by gravity into tenders; but piping connections are arranged so that, for cases of emergency, all of this water, otherwise uselessly locked up, may be delivered by the supply pump through the standpipe into the tenders, thus making this large quantity of treated water a reserve for use in emergency. This storage tank has a capacity of 250,000 gals. above the height of 21 ft. above rail level. The softener at this point, as well as that shown in Fig. 3, which is at Hazleton, Ohio, is of a capacity of 42,000 gals. per hour. It will be noticed in the latter installation (Fig. 3) that special types of elevated storage tanks are used; these tanks, however, were in use at this point before the water-softener was installed.



DETAILS OF THE SPECIAL DESIGN OF FRAME STORE HOUSE USED AT THE WATER-SOFTENING PLANTS OF 42,000 GALLONS PER HOUR CAPACITY FOR PROTECTION OF THE CHEMICALS.

The remaining four illustrations, on page 104, illustrate the use of the more usual form of elevated wooden storage tanks. In these cases it was not thought advisable to replace the old storage tanks with new ones of steel. The installation shown in Fig. 5 is that in use at Groveton, Pa., this softener being of a capacity of 42,000 gals. per hour. The remaining three softeners are each of a capacity of 21,000 gals. per hour, that shown in Fig. 6 being located at Williamsburg, Pa.; that in

Fig. 7 at Whitsett Junction, Pa., and that in Fig. 8 at Buena Vista, Pa.

As may be noted, several of these softeners are provided with housings at the top for protection to the working parts and to the attendants. All of the softeners are, however, now provided with similar housings, which were erected before cold weather last fall. In Fig. 9 is presented another view of the McKees Rocks softener, which shows it with the housing applied. These housings are built so as to provide plenty of room for convenience of access, and are very comfortably arranged.

CHEMICAL STOREHOUSES.

It is interesting to note also that careful provision has been made at each water softening plant for the proper storage of the chemicals. Storehouses have been installed at each point, of a special design, designed to protect the chemicals from the deterioration that would be inevitable under more unfavorable conditions. An accompanying drawing shows the essential features of the building that has been installed at the purifying plants of 42,000-gals.-per-hour-capacity; it is of frame construction, of the sizes and type shown, but is remarkable for the care taken to make it both air-tight and dry. The exterioı appearance of one of these buildings is shown alongside of the water-softener at New Castle Junction, at the right, in Fig. 2, page 104.

In all cases it has been designed to have the "chemical houses" large enough to hold a month's supply of chemicals—the lime in barrels, and the soda ash in bags. The storehouses used at the smaller softening plants (of 21,000-gals.-capacity per hour) are, of course, somewhat smaller than the one shown in the accompanying drawing, while that used at the McKees Rocks plant is much larger and of heavy brick construction. The important feature of the designs of these buildings has been to make them as nearly air-tight as possible to prevent the lime from "air-slacking," and also to provide against dampness; this purpose has been successfully fulfilled.

These houses are placed conveniently to the purifying plants, and where possible, conveniently to the tracks also; but the former has been given the preference. In most cases the chemicals can be handled directly from car to house; in some cases, however, it is necessary to haul the supplies by team from the car, but in all cases the pumper can handle the chemicals from the house to the purifying plant alone.

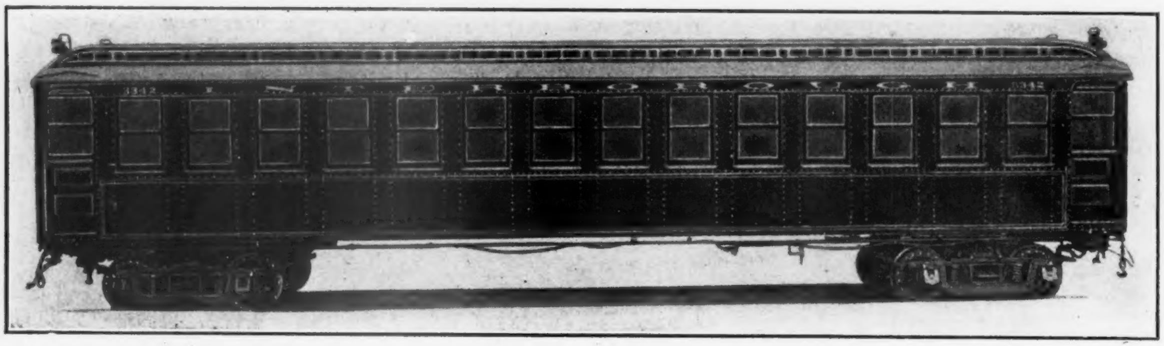
FIREPROOF CARS FOR NEW YORK SUBWAY.

The officers of the Interborough Rapid Transit Company of New York City have the credit of the first fireproof passenger car and of inaugurating a new principle which is sure to effect radical changes and introduce important improvements into the construction of passenger equipment.

Mr. George Gibbs, consulting engineer of the Interborough Rapid Transit Railway, began the designs of the new equipment of this road in 1902, and in this journal for March, 1903, the construction of the first installment of the cars was illustrated. These cars were of wood, with steel platforms and steel members incorporated in the frames, for additional strength. At the outset the necessity for perfectly fireproof construction was appreciated, but there was no precedent in the matter of design, and furthermore the market conditions rendered it impossible to place orders for steel construction at that time, even if the design had been ready. Therefore, as a large amount of equipment was needed in a short time, the wooden cars were built, and are now ready for the opening of the road. It should be recorded for the benefit of the officials of the Interborough, that the steel car design was put in hand before the lamentable accident on the Paris underground railroad. The reason for this action was an appreciation of the necessity of protecting passengers from the danger arising from the possibility of the parts of wooden cars becoming ignited by electric conductors with which the wood might come into contact in case of accident to the cars themselves or to the electrical apparatus.

The first installment of cars are undoubtedly stronger and better protected against fire risks than any equipment of any electric road at this time, as our engravings already referred to will indicate. The claims made for fireproofed wood were carefully considered and were believed to be insufficient and unsatisfactory.

The all-metal car problem was then attacked. This involved radical departures from existing practice and presented many questions, such as weight, strength, insulation from extreme heat and cold, the prevention of noise in operation, and other difficulties. The co-operation of Mr. A. J. Cassatt, president of the Pennsylvania Railroad, was obtained, and the assistance of the mechanical department of that road at Altoona, was offered. The Pennsylvania people were interested in the problem because of the necessity for fireproof equipment for the new tunnel across New York City. The design for a sample steel car was developed, and the car was completed at Altoona in about 14 months after beginning the design. It is now in service on the Second Avenue line of the elevated system in New York, and is apparently satisfactory in every respect, except as to weight, this car being about two tons heavier than the wooden ones. A new design has been prepared after this experience, and 200 cars have just been ordered from the new drawings. These will weigh the same as the first design (wooden cars) and they promise to be completely successful. The drawings of the new design are not yet available, but the photographs of the sample steel car are presented in order to record this important step in car development. Details of the framing will be presented in a subsequent issue of this journal. The leading dimensions of the sample steel car are as follows:



SAMPLE STEEL FIREPROOF PASSENGER CAR.
INTERBOROUGH SUBWAY, NEW YORK.

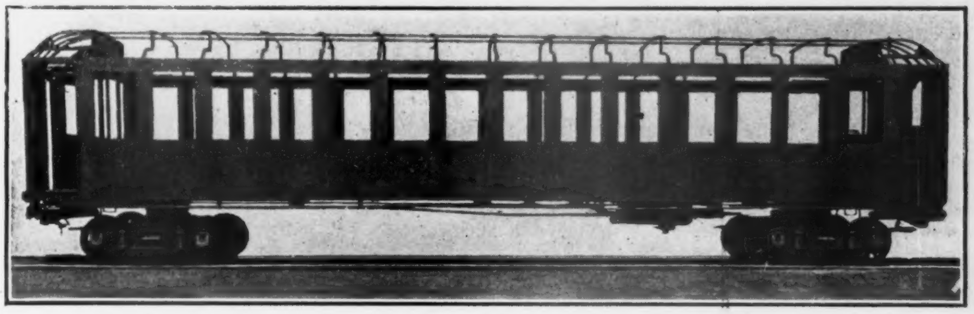
Length over corner posts	41 ft. ½ in.
Length over platforms	51 ft. 2 ins.
Width over sheathing	8 ft. 7 ins.
Width, maximum, at window sills	9 ft. ½ in.
Width at eaves	8 ft. 8 ins.
Height, sill to plate	7 ft. 1 in.
Height, rail to top of roof	12 ft. 0 ins.

Beams are used for the center sills and plate girders reaching up to the window sills supplement the side sills. The window posts are built up and are unusually wide, be-

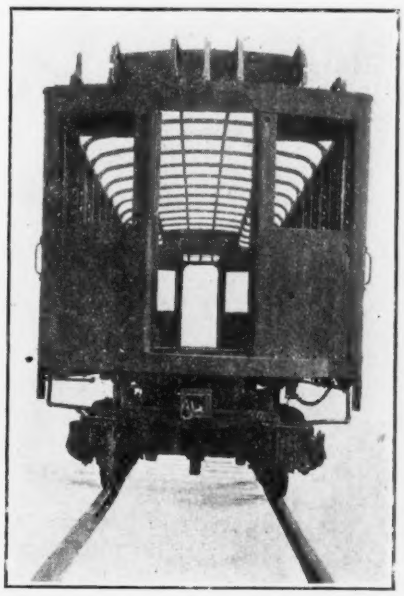
cause of the use of standard shapes. These posts extend down to the bottom of the car sides. Other details of the frame construction will be reserved for the description of the standard car. The floor is of corrugated steel, laid transversely and covered with monolithic composition. The interior finish will be of aluminum. The head lining is of pressed steel over asbestos composition and wherever possible, this composition manufactured for this road and called "Transite Board," is employed in order to deaden the noise.

The seating plan, end door and vestibules are the same as in the wooden cars. The only wood about its entire construction is in the window frames, the doors and the cross seats. In the new design the cross seats will have metal frames, leaving only the doors and window sash of wood. Even these may be made of metal if thought desirable.

This car is perfectly safe from fire and, as the entire structure will be "grounded" in case of accident, there can be no danger from contact with anything carrying heavy currents. If a collision should occur and the car rests on the conducting rail, it is sure to also come into contact with the traffic rails or the ground, and the circuit breakers at the power house will cut off the current. In the matter of fireproofing, this is the most important advance step ever taken, and it seems likely to exert a powerful influence over the construction of passenger equipment for other than electric railroad service. This is one of several features which go to make this one of the most interesting of railroads.



SIDE VIEW OF FIREPROOF CAR SHOWING PLATING AND ROOF FRAMING.



END VIEW SHOWING ROOF FRAMING.

We are indebted to Mr. George Gibbs for these photographs.

In the modern industrial railway equipment where turntables are used for outdoor work there is always a temptation to set the turntables upon too shallow a foundation, the result being that they are thrown out of line by the influence of the frost. In the new plant of the B. F. Sturtevant Company at Hyde Park, Mass., where special turntables of their own manufacture have been very successfully introduced in connection with their industrial system, each turntable rests at the top of a brick circular well with 8-in. walls extending to a depth of 4 ft. or below the frost line. These walls are set upon hard-pan and the center filled with loose stones providing perfect drainage. The first winter's experience has shown them to be absolutely unaffected by frost.

CORRESPONDENCE.

IMPROVED LOCOMOTIVE FRAMES.

OPINION OF MR. A. G. DE GLEHN.

To the Editor:

It is always with great interest that I examine the illustrations and descriptions of modern American locomotives in your most useful journal. If engineers on this side of the water have with advantages adopted principles from American practice, it would certainly seem to me that there are points in ours to which it might be worth while for American engineers to turn their attention.

One of the most characteristic features in American practice is the so-called "bar frame." It is to me especially interesting to watch its evolution from what really once was a bar frame to one which can no longer be called so with any exactness.

I should like to refer to the frame illustrated in detail in your January number, page 12. I find what I should certainly call a plate frame at the rear and at the front end; what lies in between might be called a bar frame on its way to become a plate frame, except just where it could perhaps be really most needful, that is, just over the axle boxes.

Would it not really be better, cheaper and lighter to make a real plate frame straightaway all through? The bar frame was supposed, though I could never understand on what grounds, to require less bracing. It would seem that American engineers are finding out that vertical and horizontal diagonal bracing is really necessary, and the drawings referred to show the way this bracing is carried out. We over here, of course, cannot understand how you have done without this bracing for so long, and have with interest watched for its appearance. It has certainly come to stay. But in all seriousness may one not ask: Would not such a pair of frames with their bracings, except, perhaps, at the drawbar end and where a steel casting has advantages, be better, cheaper and lighter if made, as is the universal practice over here, of plates and angle iron?

A. G. DE GLEHN.

[EDITOR'S NOTE.—In the matter of frame construction, and particularly frame bracing, foreign practice offers a good field for study for American locomotive designers. In England, Germany and France locomotive frames are substantially braced against twisting, and the frame structure of engines in these countries, with the admirable bracing, is a feature to be admired. We undoubtedly need such bracing for bar frames. It is, then, a question whether locomotives in the United States have not outgrown the bar frame. We shall go more fully into this question in a forthcoming issue.—EDITOR.]

THE RECORD-BREAKING TIRE-BORING OPERATION.

To the Editor:

On page 61 of the February issue of the American Engineer, Mr. Albert N. Reese of the West Albany shops, N. Y. C. & H. R. R. R., makes reply to my article on boring driving wheel tires which appeared in the preceding number of your paper, as follows:

"He (Mr. Pattison) has charged up the time of four helpers at West Albany and for but one at Roanoke. I think he has forgotten to charge the time of the two men which he states are required to roll tires for him, which should be accounted for. * * * Since sending you the article published in your November issue, we have done very much better, but do not think it necessary to publish it. * * * Taking the same figures which Mr. Pattison has used, we have the following results, proving that Mr. Pattison has made

a slight mistake. * * * Charging him with three helpers as should be done, we have the following:

Time of one mechanic, 4 2-3 hours, at 50 cents per hour	$2.33
Time of three helpers, 4 2-3 hours, at 12½ cents per hour	1.74
Total time to bore 10 tires	4.07
Average cost for boring one tire	.41

Then Mr. Reese quotes the same figures used by him in his first article showing the average cost per tire to be 33 cents.

Mr. Reese is very much mistaken in his interpretation of my statements. After presenting in tabular form the details of the actual machine operations, and showing that the time of the mechanic amounted to 4 2-3 hours to bore 10 tires, I continued as follows:

"As our tires are unloaded from the cars at some distance from the shop, it requires about five minutes per tire on an average, for each of two men to bring them into the shop, and about two minutes per tire to take them out. It requires but one helper to assist in setting and removing tires on the two machines referred to above, his time being about equally divided between the two, as all lifting is done by pneumatic hoist and walking crane."

Now this certainly seems plain enough, but in order to make it clearer still, I will say that it requires five minutes per tire for each of two men to roll them into the shop, which is a total time of ten minutes per tire for one man, or 100 minutes for 10 tires; it requires two minutes for each of two men to roll them out of the shop, which is a total of four minutes per tire for one man, or 40 minutes for 10 tires. Now as "it requires but one helper in our shop to assist in setting and removing tires on the two machines," it requires but *one-half the time* of one helper to wait on each machine; and as 4 2-3 hours, or 280 minutes, were required by the mechanic on one machine to bore the 10 tires, the one-half of this time which was required of one helper to assist in placing and removing these tires from the machine, is 140 minutes. Then the *total* time required of all helpers, employed in boring these ten tires, would be 100 plus 40 plus 140 minutes, or 280 minutes, equal to 4 2-3 hours, as stated in the preceding article. The figures presented in the article referred to are, therefore, correct, making the tires cost in this shop 29 cents each as against 37 cents each in the West Albany shops.

As Mr. Reese claimed in his first article that it required four or five helpers to keep him going, we would have been justified in charging the time of five helpers against his shop, which would make the cost per tire 41 cents in the West Albany shops, as against 29 cents in this shop. We do not doubt, however, that he would be able to get along with four helpers even with no crane facilities at all.

J. H. PATTISON, Foreman Machine Shop,
Roanoke Shops, Norfolk & Western Railway, Roanoke, Va.

NUMBERING SHOP MEN.

To the Editor:

I wish to register a protest and I hope you will put your foot of disapproval down on any system of numbering of men as recommended in article on "Railroad Shop Management," on page 56, in your last issue. I believe this to be the most detestable thing in any shop, and will antagonize any intelligent man. Let these people who are studying this question try and devise something to help to elevate the men instead of lowering them like animals at a county fair. FOREMAN.

In the use of purified water sometimes trouble is experienced through foaming. A number of motive power officers are of the opinion that this cannot be altogether avoided and believe that the maximum possible amount of water space over the crown sheet should be provided. Steam never becomes dryer after it leaves the boiler and the water and steam space should be made as great as possible wherever foaming is likely to be troublesome. This is an argument in favor of the wagon top boiler.

Six foot doors on box cars have introduced new difficulties which have thus far failed to bring out construction which will prevent the doors from bulging and jamming, so that they can not be opened. Either a trussed construction or a very strong door is needed. The cost of lumber will probably prevent the latter method of overcoming the trouble and some method of trussing must be resorted to. Light channels or angles on the outside of the door will undoubtedly accomplish the purpose better than truss rods which are never satisfactory with wooden construction of any kind.

THE NEW ILLINOIS CENTRAL SUBURBAN CARS.

The new suburban cars of the Illinois Central which were described in this journal in October, 1903, page 358, have attracted considerable attention abroad and have been the subject of criticism by *The Railway Engineer* without a proper study of the problem. At the request of the editor of this journal, Mr. A. W. Sullivan, assistant second vice-president of the road, presents the following rejoinder which should be studied by all who are interested in heavy short distance passenger traffic. The Illinois Central has attacked a new problem in transportation as well as one in car design, and the report of 46 passengers leaving a train in two seconds at an intermediate station is sufficient proof of this. The subject is too important for superficial critics to treat.

"In the comments upon the car, which are made at some length, *The Railway Engineer* evinces a disposition to disparage the ultility of the design as a whole, and to convey the idea that the new features it contains have been in common use in England for many years. As a matter of fact there has never been in use in England, nor anywhere else for that matter, a car like this, nor one containing so many entirely new ideas both of design and construction. The characteristic feature of this car is the completeness with which provision is made for every essential requirement in the rapid transportation of a dense passenger traffic, with a far greater degree of security and comfort for the passengers than has ever been provided.

"To prove this statement, mention need only be made of the following points: Steel construction throughout of the underframe and upperframe, giving greater protection to the passengers against accidents and from fire. A floor plan combining with transverse seats an aisle on both sides of the car, affording access to every part of the car from either side. Side-doors which slide within the walls of the car, and end-doors with vestibules connecting all the cars, affording access from within to every part of the train. Carrying capacity far in excess of any other car, with seats for the greatest number of passengers. Perfect system of lighting, heating and ventilation. Electric connection between the side-doors of the entire train and the locomotive, giving signal automatically to the engine man of the opening and the closing of the doors. Absolute control by the train men of the opening and closing of the side-doors. Inability of passengers to expose themselves to danger. Rapidity of loading and unloading passengers without disturbance of those who remain in the cars. Distribution of passengers throughout the car or the entire train after it has resumed motion. Distribution of passengers evenly on station platforms with assurance that the train can be entered at any point. Short stops at stations, with consequent improved train schedules.

"No one of these features can be found in any carriage ever used on an English railway, nor can such results in working be obtained with any equipment now used in England.

"These cars have now been in service continuously for four months, during which time they have been tested by every extremity of weather likely to occur. The location of the Illinois Central Railroad in Chicago is one peculiarly exposed to the effects of storms, running as it does for nearly seven miles on the shore of Lake Michigan, its trains must withstand the full effects of the blizzards which sweep over the lake in winter. Since the cars went into service the temperature has ranged from 96 above to 16 degrees below zero, Fahrenheit, and during the months of December and January, heavy snow storms, accompanied by winds having a velocity of 40 to 50 miles per hour, have prevailed; yet notwithstanding these conditions, the side-doors have worked perfectly, and no trouble was experienced during the coldest weather in keeping the cars warm. The absence of opposite openings preventing draughts through the cars, there is no loss of warm air when the doors are opened.

"With reference to the carrying capacity, while there are seats for 100 passengers, there is standing room for 200 more,

making a total of 300 passengers that can be carried in each car. During the rush hours of the morning and evening the usual load is from 210 to 225 passengers per car, and it has gone as high as 260 per car with room enough to spare to admit of the conductor passing through the car to collect the tickets, and in addition to operate the car doors at stations averaging one-half mile apart.

"The width of the cars, 10½ ft., is designed to utilize the space available on tracks which are constructed 12 ft. from center to center. The average weight of the cars first built, 84,600 lbs., is somewhat heavier than of those now under construction, but is not excessive when measured by carrying capacity; the tare weight per passenger for its ultimate load being but 282 lbs., which is much less than can be obtained with any form of wooden construction. One of the new cars takes the place of two of the old, and with no increase in the weight of the train there is a greatly increased carrying capacity.

"It is, however, in the rapidity with which passengers can be received and discharged, with consequent short train stops, that a most important advantage exists in conducting the transportation service. In the ordinary operation of these trains as many as 46 passengers have been discharged from one car at an intermediate station in two seconds, and 115 passengers have left one car at a terminal station in four seconds. The service is yet too novel and the weather conditions too severe to obtain the highest results that this system of handling passengers is capable of developing, but it is even now of not infrequent occurrence that stops of 8 and 10 seconds are made in which a large number of passengers enter and leave the train, and an average of 12 to 14 seconds for all the stops of a schedule is often made with trains running full. There is comparatively little difference in the time consumed by trains at stations as between a light and heavy business, a large number of passengers being received and discharged as quickly as a few. It is in this capacity for handling a heavy business as quickly as a light business that the new cars display the advantages of the system.

"Referring directly to the comments of the *Railway Engineer*, it may be said that the Illinois Central in common with other railroads has but limited space available for the conduct of its suburban business, and because of the restrictions imposed by its environment it has been forced to adopt the improved methods made possible by the use of the new type of car, whereby its capacity for suburban transportation can be doubled without increasing its terminal facilities, its tracks, or its station and platform accommodations. This is made possible simply by the superior character and capacity of its new equipment, which utilizes to the highest degree the space between the tracks and avoids the waste of space and time incident to the use of small cars and slow methods of handling passengers. The principle of large transportation units and facility for quick dispatch holds good for passenger business equally with freight, with the same certainty of result that the higher efficiency of the new methods will be productive of larger revenues. While to the English eye the new cars look huge and magnificent, they are less expensive to construct than cars of the same capacity built to the ordinary dimensions of wooden car construction, and possess the further important advantage of greatly increased security from casualty incident to steel construction.

"The statement of the *Railway Engineer* that the wide suburban carriages of the Great Eastern Railway, designed by Mr. James Holden, are 28 ft. 2½ ins. long over the buffers and 9 ft. wide at the waist; that they have five compartments, each seating 12 passengers, and that they tare on the average 10 tons, 6 cwt., which is equal to 387.53 lbs. per seat, is true for the second and third class carriages; but is not true for the first class, which for the same dimensions have four compartments, each seating 10 passengers, or a total of 40 passengers against 60 for the second and third class carriages, a difference which will require some revision of the tare weight per seat."

A. W. SULLIVAN.

H. H. VAUGHAN.

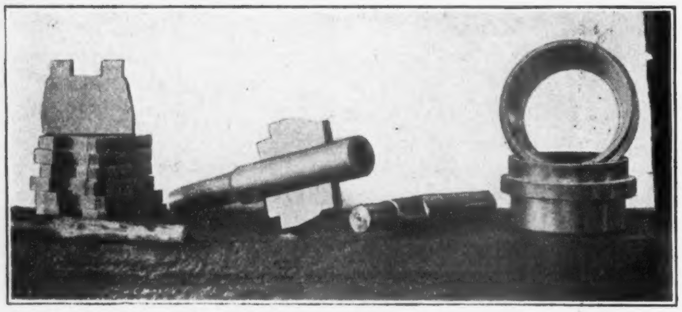
It is a pleasant task to announce to our readers the appointment of Mr. Vaughan as superintendent of motive power of the Canadian Pacific Railway. It is a remarkable accomplishment for a young man to come to this country a perfect stranger, as Mr. Vaughan did twelve years ago, and in these years advance from the operation of a lathe in the shop to the position of assistant superintendent of motive power of the Lake Shore, and from this to be called to take charge of the motive power responsibilities of such a road as the Canadian Pacific. It is a source of satisfaction to see one's opinions verified and to find that predictions have become facts. This appointment indicates the appreciation of an experience which includes an education begun at a technical school, supplemented by shop experience which enabled the man to hold his own as a workman among strangers, this being followed by some years in test work and drafting rooms, and then by valuable commercial experience which included the designing and construction of machinery and the management of a successful manufacturing enterprise. He was called to return to railroad work, for which he is eminently well fitted, and it is to be hoped that his abilities are to be directed for many years in this work, where many men like him are so greatly needed. There are no railroad positions so difficult to fill as those of the motive power department. Here are concentrated the problems of the engineering of the locomotive, the management of large works and shops, the operation of a large number of locomotives on the road, and the organization having more possibilities for economy through efficiency than any other. This requires a combination of mechanical engineer, business man, organizer and executive in a man who will not allow himself to be swamped by details. The railroads will do well to encourage to the utmost the men who are acquiring experience to fit them for such work, and it is good to see such a wise and promising appointment.

Mr. Vaughan was born in England, graduated from Kings College, London, served an apprenticeship at the works of Naysmith, Wilson & Co. at Patricroft, England, and after that worked as a machinist for a short time at the Gorton shops of the Manchester, Sheffield & Lincolnshire Railway, and at the Nine Elms shops of the London & South Western Railway. In 1891 he came to the United States and entered the shops of the Great Northern as a machinist, and soon became mechanical engineer of that road under Mr. J. O. Pattee. In this position he developed marked ability in designing many devices, such as the present engineer's valve of the New York Air Brake Company. In 1897 he went to the Philadelphia & Reading as mechanical engineer, and two years later took charge of the management of the shops and mechanical engineering development of a manufacturing establishment in Chicago. Here he acquired a valuable commercial and manufacturing experience and the management of men. In March, 1902, he was called to the Lake Shore & Michigan Southern Railway as assistant superintendent of motive power under Mr. H. F. Ball. In two years, by his ability and his pleasing personality, he accomplished important work in a way which won enduring friendship all through the department. His keen intellect, clear observation and direct thinking have given him a broad outlook, which compasses the needs of the times in a way which promises success in the great motive power problem. It is encouraging to know that the railroads appreciate such men, and the Canadian Pacific is to be congratulated upon securing so valuable a man.

Overhead traveling cranes should not be used to place work in machines. Jib cranes for such large machines are better. They are always available for the attendant and may be used individually without causing others to wait. The traveling crane should be considered as an overhead railroad for transportation purposes only. Several times mistakes have been pointed out to the writer, indicating the importance of this question.

REAMERS FOR ROD PACKING CUPS.

At the Albuquerque shops of the Atchison, Topeka & Santa Fe Railway, Mr. W. L. Essex, general foreman, showed the representative of this journal a business-like contrivance for reaming piston rod packing cups to standard sizes and to exact interior contours. In the engraving the whole set of parts and a pile of reamers of different sizes are shown. One of the reamers is keyed in place in the bar, ready for the work, which is done in a lathe. The cups are held in chucks and the



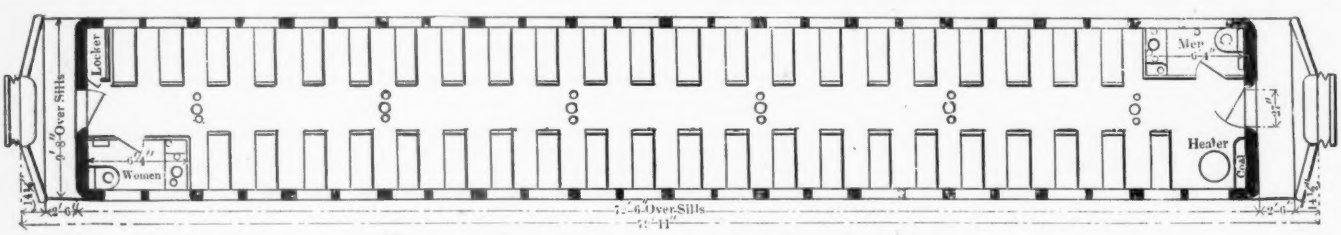
STANDARD RECEIVER FOR ROD PACKING CUPS.

boring bar is held by the centers. The rod at the left in the engraving passes through a hole in the boring bar to prevent it from turning. This process insures accurate fitting of all cups and is very rapid and inexpensive. The sizes of rods to be fitted are kept standard in 1-16-in. variations and cups are kept in stock for all sizes. It will pay every railroad to fit up devices for insuring accuracy in the important matter of maintenance of rod packing.

80-FOOT FIRST-CLASS COACH.

GREAT NORTHERN RAILWAY.

Twenty coaches, 80 ft. in length, have been built for the Great Northern by the Barney & Smith Company. They provide seating capacity for 86 passengers and weigh 111,250 lbs. The chief dimensions are as follows: Length over buffers, 81 ft.; length over platforms, 79 ft. 11 ins.; length over sills, 72 ft. 6 ins.; width over sills, 9 ft. 8 ins.; width over crown molding, 10 ft. ½ in.; transom centers, 55 ft. 10½ ins.; total



80-FOOT, FIRST-CLASS COACH.—GREAT NORTHERN RAILWAY.

wheel base, 66 ft. 10½ ins.; wheel base of 6-wheel trucks, 11 ft.; diameter of wheels, 42 ins.; size of journals, 4¼ x 8½ ins.; journals, collarless.

The cars are finished in mahogany inside, with painted canvas headlining. The lighting is by acetylene gas. The heating system is that of the Safety Car Heating and Lighting Company, with 579 ft. of 1¼-in. pipe. The cars have wide vestibules and 6 ft. 4 in.-toilet-rooms. They are reported to be very satisfactory in riding qualities. We are indebted to Mr. G. A. Emerson, superintendent motive power, for the drawing.

MACHINISTS AS TEACHERS.

So far as we are concerned, the business use of our lives is to take material of a low value and convert it into things of a higher value, and that, too, is the business of the teacher, and there is no reason why the teacher should occupy any higher place than the machinist, except that they are dealing with more valuable material. The best mechanics are those who make the selection of material best suited to the purpose. The teacher is at present restricted to working all sorts of material through the same mill, whereas if the trades were added to the possessions instead of teachers' duties being those of turning the mill to grind out two-legged animals to fit the Board of Regents' standard gauge, their most successful members would be those who could best guide their material into its most useful channel.—Prof. J. E. Sweet, in a paper on the Apprentice Question, read before the Metal Trades Association.

One thing that motive-power officers are not thinking enough about is the design of their locomotives. In visiting a large number of railroads one is struck with the fact that the locomotives generally have the appearance of being "manufactured," rather than built to conform to the ideas of the railroad officers with respect to local conditions. It is easy to tell from which of the locomotive builders' shops a new locomotive has come. The general appearance of locomotives indicates a degree of indifference to the arrangement of detail which goes to make up a handsome result, of which the locomotive is thoroughly worthy. Exceptions only prove the rule. Upon inspecting a locomotive which bears evidence of careful consideration of its appearance one is sure to discover evidences of thoughtful and careful design in the whole or in details, which inspires confidence that the engine will give a good account of itself. Motive-power men cannot afford to ignore this matter or to leave to the builders too much responsibility for results. They should take advantage of all of the ability and experience of the builders, and then be sure that the details are worked out to suit the local conditions, which no one but those who operate and maintain the equipment can thoroughly understand. This can be done without additional expense, and those who do it will be likely to obtain a higher degree of success in their calling than those who do not. The specialization of locomotives becomes more necessary every year, and a transcontinental trip will convince anyone of the great variety of local conditions which must be met by thorough knowledge and experience in operation and maintenance. The pursuit of symmetry and handsome appearance can easily be carried too far, but efforts in this direction reflect that which is to be desired—more careful design. A handsome engine is generally a very good engine.

A rather general movement is on foot to increase the size of hand holds on freight cars. It is however one thing to increase the size of the iron used and quite another thing to gain the full value of such increase. This cannot be done unless the method of fastening the hand holds to the cars is improved. These parts are now secured exclusively by bolts on one large system, no lag screws being used for this purpose. This is an important improvement which will undoubtedly be introduced generally for ladders as well as hand holds.

The Consolidated Railway Electric Lighting & Equipment Company announce the removal of their general offices in New York City, from 100 Broadway, to the Hanover Bank Building, corner of Nassau and Pine streets.

PERSONALS.

Mr. C. A. V. Axen has been appointed general foreman of the shops of the Chicago & Northwestern at Kaukauna, Wis., to succeed Mr. R. Whittier.

Mr. D. J. Malone has been transferred as master mechanic of the Oregon Short Line at Salt Lake City. He has been master mechanic at Pocatello, Idaho. Mr. W. J. Tollerton succeeds Mr. Malone at Pocatello.

Mr. H. W. Ridgeway has been appointed master mechanic of the Mexican Central at the City of Mexico. He was formerly superintendent of motive power of the El Paso & Northwestern and succeeds Mr. C. W. Wincheck, resigned.

Mr. J. A. Pfeiffer heretofore erecting shop foreman of the Atchison, Topeka & Santa Fe at the Topeka shops, has been appointed general foreman of the shops of that road at Winslow, Ariz.

Mr. J. N. Barr, assistant to the president of the Chicago, Milwaukee & St. Paul, has been granted leave of absence for six months on account of ill health. It is understood that he will spend this time in California.

Mr. William Cross, engineer of tests of the Canadian Pacific, has been appointed assistant to the second vice-president of that road. He will have charge of motive power west of Fort William, Ontario, with headquarters at Winnipeg, Man.

Mr. Thomas Paxton has accepted the appointment of master mechanic of the St. Louis, Iron Mountain & Southern, with headquarters at Baring Cross, Ark., to succeed Mr. George Dickson.

Mr. J. N. Sanborn has been appointed superintendent of motive power of the Texas Southern, with headquarters at Marshall, Texas. He has been promoted from the position of master mechanic of this road at Marshall.

A dynamometer car is being built by the American Car & Foundry Company, for the International Correspondence Schools. It will be modeled after the dynamometer car of the Chicago, Burlington & Quincy, and it is stated that a number of roads have already expressed a desire to use the car.

Mr. T. U. Cutler, master mechanic of the Northern Pacific at Fargo, N. D., has been transferred to the same position on the Rocky Mountain division at Missoula, Mont., to succeed Mr. W. F. Buck, and Mr. Cutler is succeed at Fargo by Mr. J. E. O'Brien.

Mr. H. C. Shields has been appointed master mechanic of the Lehigh & New England, with headquarters at Pen Argyl, Pa. He has been division foreman of the motive power department of the Delaware, Lackawanna & Western at Bangor, Pa.

Mr. James Connors has been appointed district master mechanic of the Chicago, Milwaukee & St. Paul, with headquarters at Dubuque, Iowa, to succeed Mr. George H. Brown, who has been assigned other duties. Mr. David Patterson succeeds Mr. Connors as general foreman at Dubuque.

Mr. J. J. Reid has resigned as mechanical inspector of the Northern Pacific Railway to accept the appointment of general master mechanic of the Louisville & Nashville Railroad with headquarters at Louisville, Ky. Mr. Reid will have general charge of all the shops of the line as well as other responsibilities.

Mr. A. W. Wheatley has been appointed assistant superintendent of motive power of the Northern Pacific with headquarters at St. Paul, Minn. He has been superintendent of shops of that road at Brainerd, Minn., where he is succeeded by Mr. U. N. Anderson, formerly general foreman.

Mr. U. L. Driscoll heretofore master mechanic of the Cincinnati, New Orleans & Texas Pacific at Chattanooga, Tenn., has been appointed master mechanic of the Alabama Great Southern at Birmingham, Ala., to succeed Mr. V. B. Lang, resigned. Mr. Driscoll is succeeded at Chattanooga by Mr. W. H. Dooley, heretofore master mechanic at Somerset, Ky. Mr. Dooley is succeeded by Mr. D. Brown, heretofore general foreman at Somerset.

Mr. James C. Cassell, general superintendent of the Norfolk & Western Railway, has been appointed assistant to the president. Mr. Cassell began railroad services in 1871 as a telegraph operator on the Pennsylvania and has steadily advanced to his present position. He has been connected with the Norfolk & Western for twenty-five years and has occupied every position in the operating department, from dispatcher to general superintendent.

Mr. C. F. Giles, master mechanic of the Louisville & Nashville, at Louisville, Ky., has been promoted to the position of assistant superintendent of machinery, with headquarters at the same place, to succeed Mr. H. Swoyer, who recently resigned. Mr. W. L. Tracey, assistant master mechanic, succeeds Mr. Giles, and Mr. J. G. Clifford, master mechanic at South Louisville, succeeds Mr. Tracey. Mr. J. J. Sullivan, master mechanic at New Decatur, Ala., succeeds Mr. A. Beckert, recently resigned.

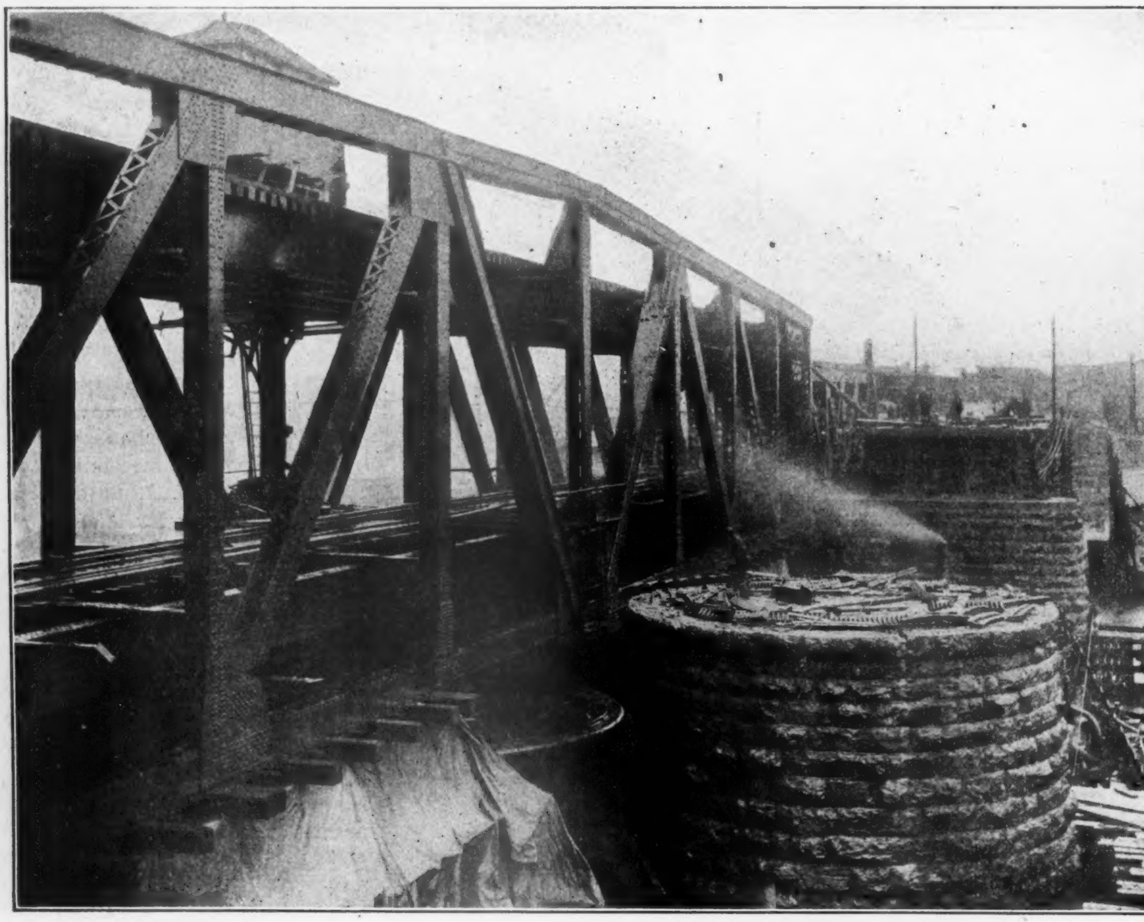
The Master Mechanics' Association Committee on Cost of Shops has prepared blank forms for distribution to members for the purpose of securing data concerning the cost of recently constructed shop plants. The blanks are very well arranged, and it is to be hoped that they will receive the best possible attention from those who have these important figures at hand. This committee will be enabled to do a valuable work, if they are placed in possession of information which will enable them to state the cost of buildings of various types and of equipment of the various departments of locomotive shops and power houses. Those who have recently been called upon to estimate the probable cost of new shops, will appreciate the value of general information of this kind, and the report, if complete, will be one of the most useful undertakings which the association can take up at this time.

The United States Government has placed the first exhibit at the World's Fair in St. Louis. It consists of a postal car, built in the Altoona shops of the Pennsylvania Railroad. The United States Government's extensive display includes the inner works of the postoffice department, of which the railway postoffice service is an important part. To properly demonstrate that feature a postal car similar to those operated on the Pennsylvania-Vandalia system was selected by the government as representing the most advanced ideas in devices for the expeditious handling of United States mail. The car placed in the United States Government building at the World's Fair is No. 6542. When the new postal car was recently placed in the Government building at St. Louis, it was photographed under the immense arches of steel, which compose the framework of that exhibit palace, the only steel-framed structure on the ground. The handsomely finished sides of the car are covered with heavy canvass to protect it until the opening of the Exposition, April 30, when visitors to the World's Fair will be privileged to witness postal clerks at work in the car, showing how the mails are distributed and handled on fast trains of the Pennsylvania-Vandalia system in eleven States.

A 1,000 TON DRAWBRIDGE MOVED AND LOWERED BY SAND JACKS.

DELAWARE, LACKAWANNA & WESTERN.

The lifting of a thousand ton steel drawbridge through a height of 20 ins. so that it will clear its old supports; its transfer upstream a distance of thirty-five feet and its final lowering to a new pivot pier ten and a half feet lower than that on which it originally rested, is an engineering feat of more than ordinary importance. And when it is accomplished in a space of twelve hours with unfavorable tides, winds and river currents, it becomes all the more remarkable. Yet this is what was performed by Chief Engineer Bush of the Lackawanna Railroad recently in transferring a new steel double-deck draw span from old to new piers across the Passaic River, at Newark, New Jersey.



DRAW-BRIDGE OVER THE PASSAIC RIVER, AT NEWARK, N. J.—DELAWARE, LACKAWANNA & WESTERN RAILROAD.
VIEW FROM PIER ON NEWARK SIDE AS DRAW SPAN WAS BEING LOWE RED ONTO THE NEW PIVOT PIER. OLD PIVOT PIER AT RIGHT; SAND JACKS COVERED WITH CANVAS.

The Lackawanna have for some time past been engaged in developing great improvements in elevating their tracks through Newark and eliminating a large number of grade crossings, to accommodate their greatly increasing suburban traffic. On December 20 the elevated structure was put into commission by the moving of the enlarged draw span from the original location to the new right of way. In March, 1901, a new double-deck draw span, 220 ft. long, had been erected at this point to replace an old bridge not sufficiently strong for the steadily increasing traffic. The new bridge was suitably designed for the elevation work through Newark and Harrison that was to come later, the lower deck being used for carrying the main line traffic. The lower deck will now be used for a single track approach to the new freight yard at Broad street, Newark, at the street level, while the upper deck, heretofore unused, is now occupied by the two main line tracks. The new grade and location of elevation work were such as to require the bridge to be moved 35 ft. north of and parallel to the old location and placed 10½ ft. below the old elevation. The bridge weighed, ready for removal, 1,017 tons.

It is a simple matter to move a bridge and raise and lower it through a small difference in elevation but to drop it ten to twelve feet exactly on top of a pivot pier located in a strong tideway, is a more troublesome operation. The secret of its successful accomplishment dates back to the early Egyptians, who, in spite of their lack of machinery, were accustomed to seal the tombs of their dead with enormous stone slabs. For many years scientists have wondered how these stones of such size were lower into a sarcophagus, until it was discovered that the idea of the sand-jack was made use of, in that a column of fine sand upon which they rested, was allowed to run out from underneath, allowing the slab to settle firmly into place.

Probably nothing like the huge sand bins used in this modern work has ever been seen before. Four immense boxes, 11 ft. high, 5 ft. wide and 54 ft. long, were built on scows, and carried the sand which in turn supported the plungers which held the bridge. The sand boxes and plungers were so constructed that the difference between the elevation of grade line of the bridge on the old location and the grade line of the bridge on the new location, amounting to ten and a half feet, was taken care of by letting out the sand in the cylinders. A set of slides controlled the orifices through which the sand was allowed to run out, and so perfectly was the work performed that the bridge settled into place without so much as a scratch. The variation in the height of the tides and the lifting of the bridge from its old location onto the scows, as well as the releasing of the scows from underneath the bridge in its new location, were controlled by means of water ballast, which was pumped in and out of the four scows by four centrifugal pumps each having a capacity of 1,600 gals. per minute.

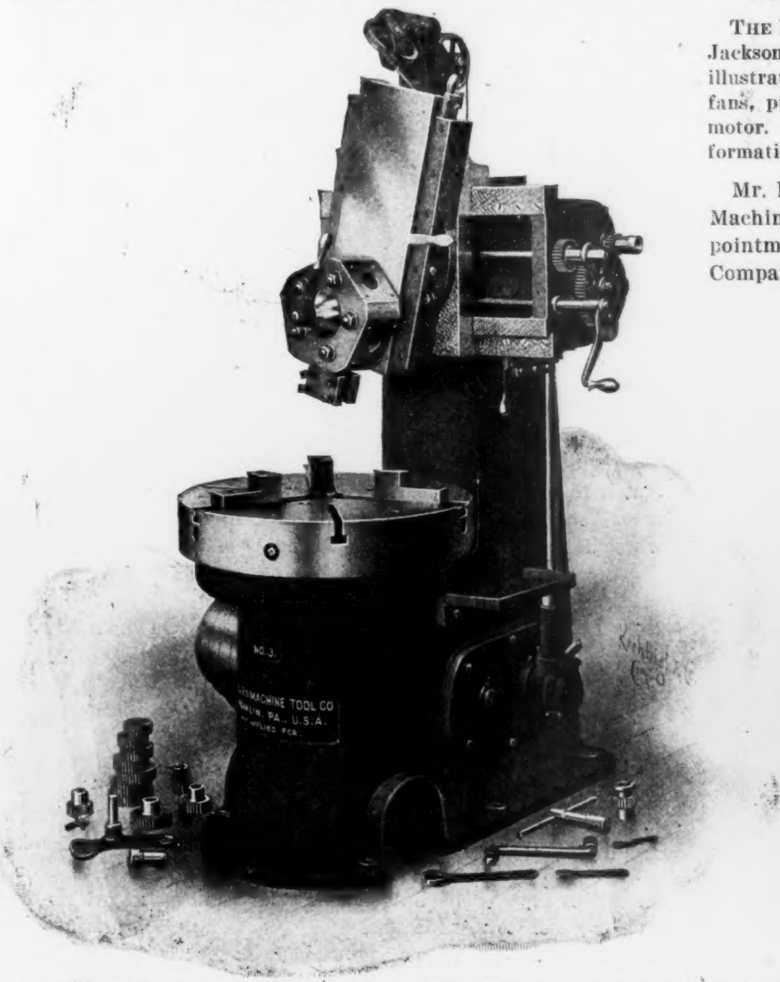
The four scows were secured under the bridge at low tide, and elevated by removing the water ballast to within a few inches of the bottom of the bridge. When the tide began to rise the immense drawbridge was lifted from its pivot of granite in the middle of the river and the floats were then drawn up stream with their burden until the bridge was poised above the new pier and between the newly laid elevated tracks. Then the sand in the boxes was permitted to run out from the holes and the plungers carrying the weight of the bridge sank steadily and evenly into place. The work was started at 4 a. m. and the bridge touched the new pivot pier at 5 p. m., completing a connection that renders possible the handling of the road's immense suburban traffic in a most satisfactory way.

A MODERN BORING MILL.

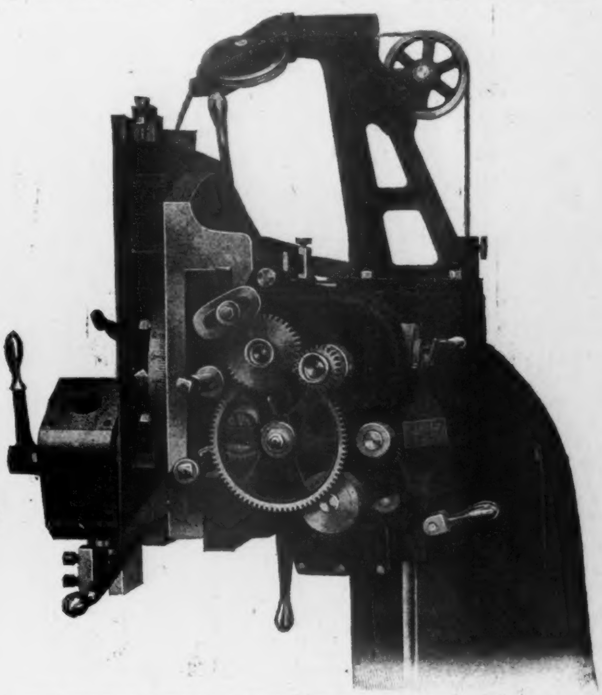
COLBURN MACHINE TOOL COMPANY.

The important part which the boring mill is coming to take in modern machine shop practice and in rapid duplicate manufacturing is fully recognized by railroad shop managers, and its use in this direction is rapidly extending. Nothing has done more to develop modern methods of manufacturing than the boring mill and its easy methods of chucking and control.

One of the most modern and efficient tools, at present upon the market, is the boring mill manufactured by the Colburn Machine Tool Company, Franklin, Pa. A line of these tools ranging in size from 34 to 78 ins. is manufactured by them. Of these the 34-in. size is illustrated herewith. A characteristic strength and solidity of design is easily recognized in this machine, especially as regards the heavy chuck or table.



THE 34-INCH VERTICAL BORING AND TURNING MILL, WITH TURRET HEAD AND SCREW CUTTING ATTACHMENT.—COLBURN MACHINE TOOL COMPANY.



SIDE VIEW OF HEAD OF THE 34-INCH COLBURN BORING MILL, SHOWING DETAILS OF THE SCREW CUTTING ATTACHMENT.

Some of the more important features of this tool may be of interest. It is supplied with either a plain table or 3 or 4 jaw chuck. The turret is five sided, and the turret slide swivels 30 degrees either side of the perpendicular; the counterweight for the slide is carried inside the column, doing away with the overhanging arms and chains which are usually employed on mills of this size. The drive on these mills is what is called a parallel drive, enabling the machine to be set on a crane floor and belted up to a line shafting running lengthwise along the crane columns of a shop.

A scale and pointer is furnished on the vertical slide to enable duplicate work to be done to exact depth; this is not shown on the cut, but it is a very desirable feature. The gearing is powerful, with 16 changes of speed; there are 10 changes of feed. Practically all parts of the machine are jig drilled, making them interchangeable—a very important feature when repair parts happen to be needed. Further information will be gladly supplied regarding any of these tools by the Colburn Machine Tool Company.

THE PHOSPHOR-BRONZE SMELTING COMPANY.—A revised price list, No. 22, of "Elephant Brand" phosphor-bronze has been issued by these manufacturers to take the place of all previous lists and quotations. The new rolling mill is now in successful operation, and, with greatly improved facilities and a well-assorted stock, this company is ready to supply all requirements. Correspondence should be addressed to 2200 Washington avenue, Philadelphia, Pa.

FAIRBANKS, MORSE & CO.—A new catalogue of hoists and mining machinery operated by gas, gasoline, crude oil or producer gas has been issued by Fairbanks, Morse & Co., Franklin and Monroe streets, Chicago. In addition to this line of machinery, in which they have established a valuable reputation, this company manufactures a complete line of hoisting machinery operated by steam, including both flat friction and geared hoists.

THE DAKE SQUARE PISTON ENGINE.—The Holland Company, 77 Jackson boulevard, Chicago, in their circular No. 41 describe and illustrate their motor for air or steam power for operating blowers, fans, pumps and generators, or any service requiring a compact motor. The pamphlet gives the sizes of the machines and all information necessary for ordering.

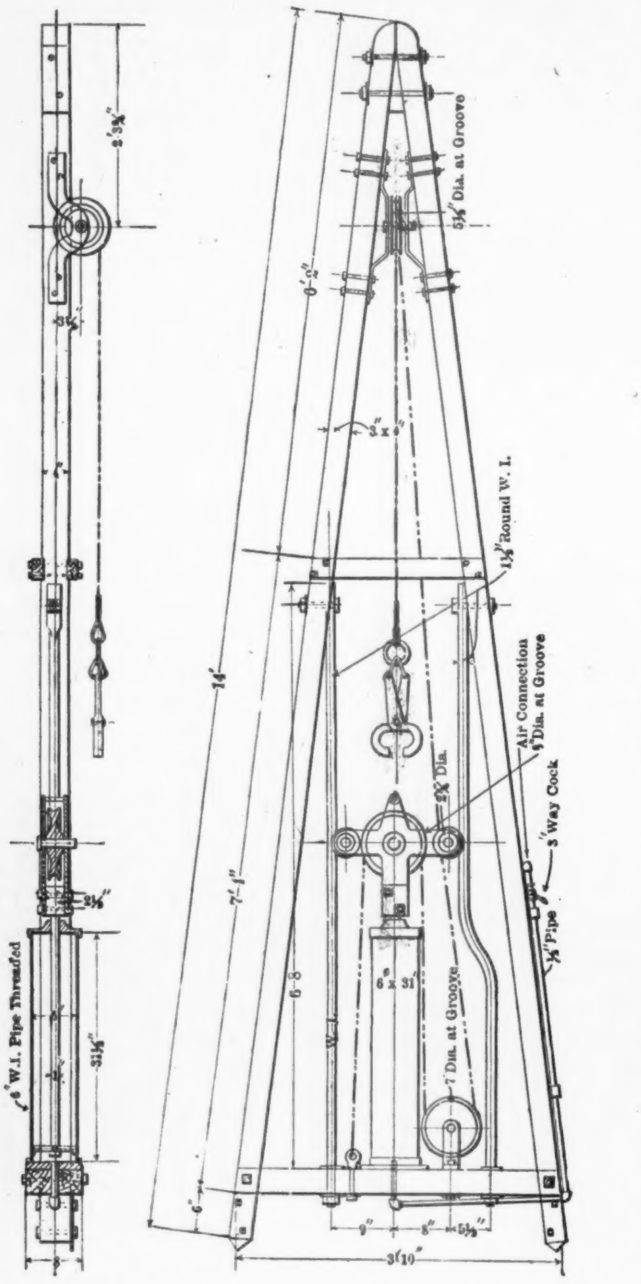
Mr. David Hunt, Jr., has resigned as treasurer of the Baush Machine Tool Company, of Springfield, Mass., to accept the appointment of general sales manager of the Warner & Swasey Company of Cleveland. Mr. Hunt was formerly, for several years, connected with the sales department of Messrs. Manning, Maxwell & Moore, and has a wide acquaintance among railroad men and other users of machine tools.

THE STAR BRASS MANUFACTURING COMPANY has moved its Chicago office from the Monadnock building to 303 Fisher building. Mr. W. T. Johnson is in charge.

Colonel John T. Dickinson, vice-president of the Consolidated Railway Electric Lighting & Equipment Company, general offices, Hanover Bank Building, New York, is authority for the statement "that the Consolidated company has more of its 'Axle Light' equipments of electric car lighting in use on the best cars constituting the finest trains of leading railway lines than all other systems of electric car lighting combined. Also, that the chief mechanical officials of several of the great railway systems in the country, where a large number of 'Axle Light' equipments have been in service for the past few years, have concluded that Consolidated 'Axle Light' is the cheapest to install and maintain, and the most efficient system of electric car lighting ever yet devised. Each car carries its own independent electric car lighting apparatus, ready for immediate and constant use, no matter in what service the car may be placed."

PORTABLE AIR HOIST FOR LOADING CAR WHEELS.

This engraving illustrates a convenient air hoist for handling car wheels into or out of box cars. It is leaned against the roof of the car and an air hose is connected to the yard supply. The air cylinder is 6 x 31 ins., and uses air at 100 lbs. per sq. in. It is in use on the Lake Shore & Michigan Southern Railway. We are indebted to Mr. L. G. Parish, master car builder at Englewood, Ill., for the drawing.

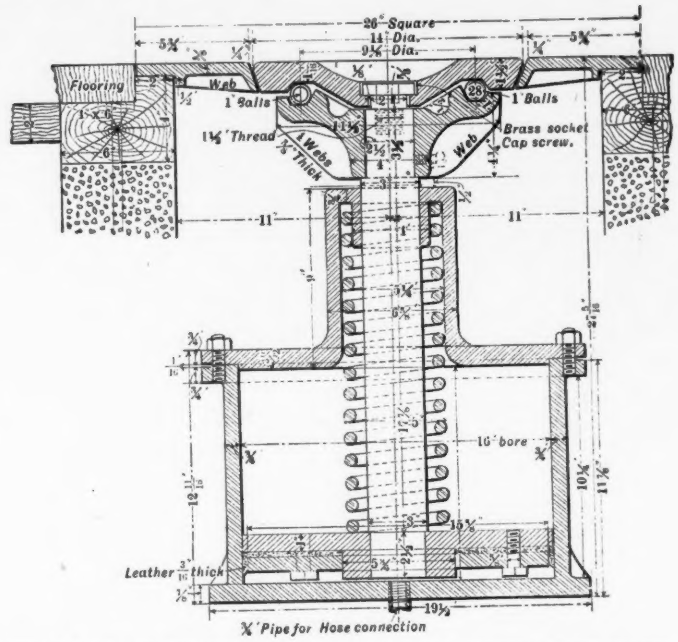


DETAILS OF THE PORTABLE HOIST FOR LOADING WHEELS.—L. S. & M. S. RAILWAY.

PNEUMATIC CROSSING JACKS FOR PUSH CARS.

For a number of years jacks of this general character have been used at the Topeka shops of the Atchison, Topeka & Santa Fe. They cost very much less than turntables and are specially convenient in tracks which must be used for locomotives, where small turntables could not be employed.

This jack is operated by a conveniently located air valve. The plate on the top of the piston rod is brought up under the push car, which lifts the car off the rails. The car may then be easily turned on the ball bearing and let down upon the other track. Water-tight pits of concrete are built for these jacks, and when in the normal position the top plate lies flush **with the floor plate, as shown in the drawing. The pits are 22 ins. square, with 9-in. walls and 9-in. floors. To return the**



DETAILS OF AIR CYLINDER AND BALL BEARING SWIVEL JOINT UNDER THE PLATE.

piston to its normal position, the piston rod is surrounded by a coil spring of 5-16-in. wire in 15 coils, the free height of which is 2 ft. and the outside diameter of the coil 5 ins.

A NEW DESIGN OF STEEL-FRAME MOTORS AND GENERATORS.

TRIUMPH ELECTRIC COMPANY.

Recognizing the modern demand for electric motors and generators to be extremely compact and strong, to be efficient and durable, and to be capable of withstanding fluctuating loads and heavy overloads, the Triumph Electric Company, Cincinnati, Ohio, have recently placed on the market a new series of designs of bipolar machines, with steel frames, for use as motors or generators, in the sizes of ½ to 5-h.p. In this new design it was sought to produce a machine that is simple in construction, does not easily get out of order and requires but little attention; and, moreover, one that can be placed under the care of an inexperienced attendant and be always ready for service.

The accompanying engravings illustrate, in one case, a 1-kw. machine, arranged for use as a slow-speed generator, and the other, the unassembled parts of a ½-h.p. motor of the new type. An important feature of the general design is its compactness. The arrangement of the yokes serves also to make the machine perfectly iron-clad.

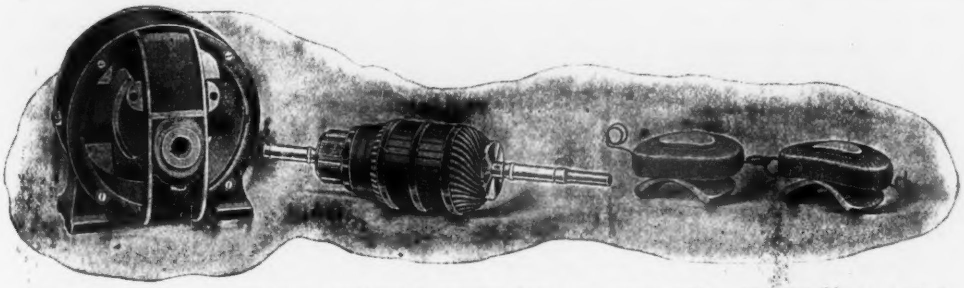
The frame and pole pieces are of soft close-grained steel, the pole pieces being accurately fitted within the crown and bolted in for ease of removal if necessary. The yokes may be removed by loosening 4 bolts each, and can be mounted in any position, thus making the machine easily available for floor, wall or ceiling use without change.

The field coils are form wound and thoroughly insulated. Every coil is soaked in a varnish bath, then baked, after which it is covered with two layers of friction tape, finally receiving two coats of insulating paint. This construction makes the field coil practically indestructible. Each coil on completion is tested with alternating current.

The armatures are of the usual laminated construction, but on these machines notched discs are used and they are annealed after punching and varnished before assembling—the

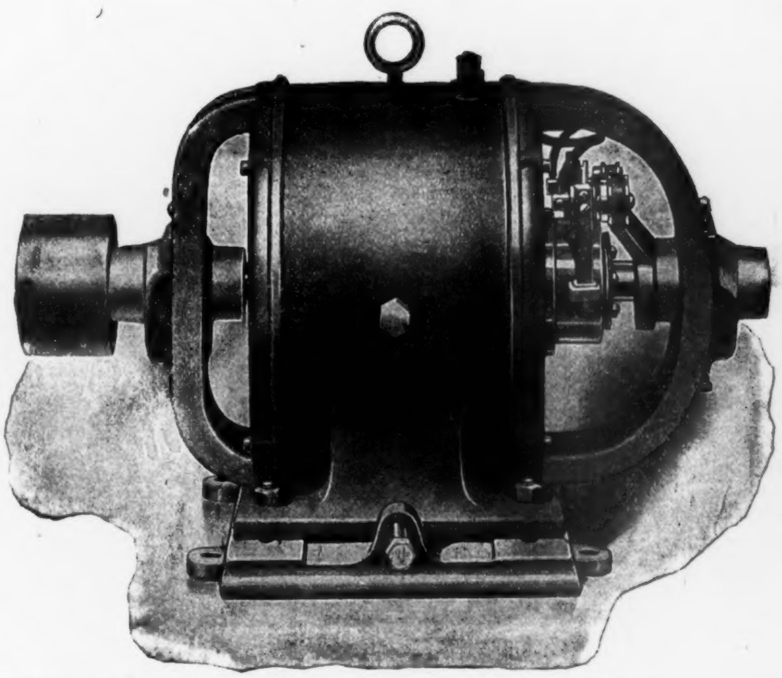
most approved construction. The armature coils are embedded in the notchings, with most thorough insulation, thus reducing the air gap and making most efficient machines. The commutator shell is of a new design, making it impossible for a segment to get loose and cause trouble. The brush holders are simple, light and effective, and are so set as not to require adjusting under any condition of load or overload.

These machines are rated well within their limits of capacity, and, as open machines, no part will heat more than 40 degs. Cent. over the surrounding air, when operated for 10 hours under full load. They will withstand an overload of 50 per cent. for a period of one hour, and a momentary overload of 100 per cent. without injury. As entirely enclosed machines the ratings will be somewhat less, to meet these requirements.



DETAIL VIEWS OF THE FRAME, ARMATURE, POLE PIECES AND FIELD COILS OF THE ½-H.P. STEEL FRAME MOTOR.

No expense, either in quality of materials, workmanship or in care of testing, has been spared to make these machines as nearly perfect as possible. They are built, as motors, in sizes from ½ to 5-h.p., and as generators, from ½ to 5-kw., inclusive. The Triumph Electric Company also builds larger machines, for belt-drive and direct connection, the particulars regarding which may he had upon application.



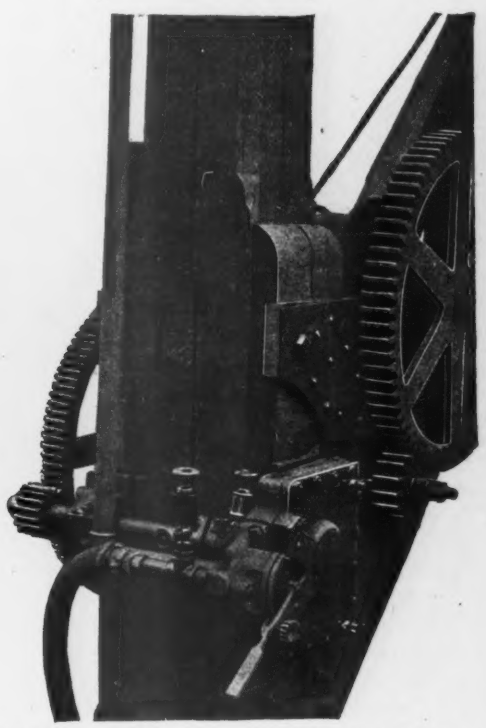
GENERAL VIEW OF THE 1-KW. SLOW-SPEED STEEL-FRAME GENERATOR.—TRIUMPH ELECTRIC CO.

THE DAKE SQUARE-PISTON ENGINE.

Probably there can be no simpler way in applied mechanics, to obtain a rotary motion from the force and expansion of steam than that employed in the construction of the Dake engine. Reduced to its simplest elements it consists of nothing but two movable pieces, one sliding inside the other, and both floating in a square, steam-tight box or cylinder, and being guided in their movements by the crank on the end of the driven shaft.

The Dake motor provides a cheap and very effective means of changing jib cranes from hand to power cranes, as shown in the accompanying illustration. In nearly all railroad yards, foundries, machine shops, boiler works and structural steel plants, where compressed air power is used, this motor can be very profitably applied for driving jib cranes. The accompanying illustration shows an unloading jib crane in a railroad yard, formerly operated by two men on either side with cranks; the cranks were removed and the motor bolted to the side of the mast without changing the gearing.

This machine can be bolted to the mast of any jib crane and will raise and lower the load at any desired speed and in a reliable manner. If it is desired to rack the load on the boom or raise and lower the boom, as the case may be, in addition to raising and lowering the load, a double drum hoist is furnished, by which the load can be raised and lowered independently of racking it, or otherwise operating the boom.



DAKE MOTOR AS APPLIED TO A JIB CRANE FOR HOISTING. FOR USE WITH COMPRESSED AIR.

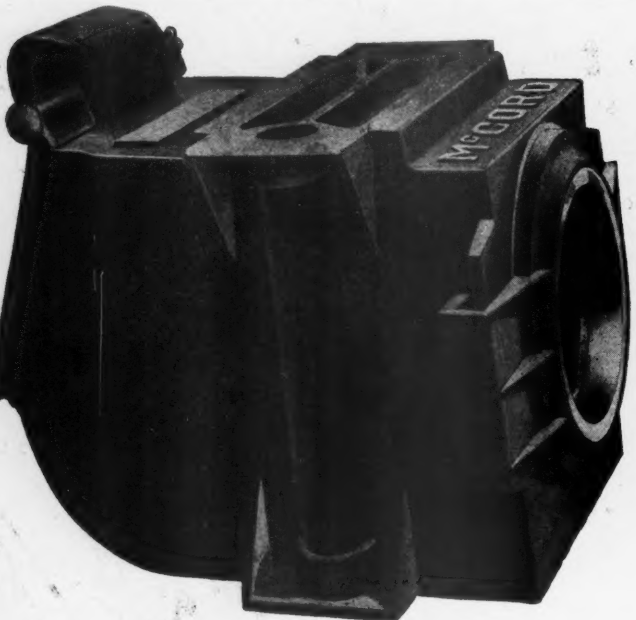
The Holland Company, who supply this motor to the trade, have recently issued a new circular (No. 41) devoted to the Dake square-piston engine, for use with compressed air or steam. The motor is illustrated in detail, and this circular will be of interest to all who are interested in motors of small sizes. The Dake motor operates upon a very interesting principle and, as a prime mover, is one that requires very little attention and is very durable. It is carefully provided with all necessary adjustments and the wearing surfaces are of phosphor bronze and can easily be renewed.

This motor is built in sizes ranging from 1 to 30-h.p., and can be supplied for direct-connection to machines, as reversible engines, or with throttling governor for use as a constant-speed stationary engine. Further particulars will be gladly supplied by the Holland Company, No. 77-83 Jackson Boulevard, Chicago, Ill.

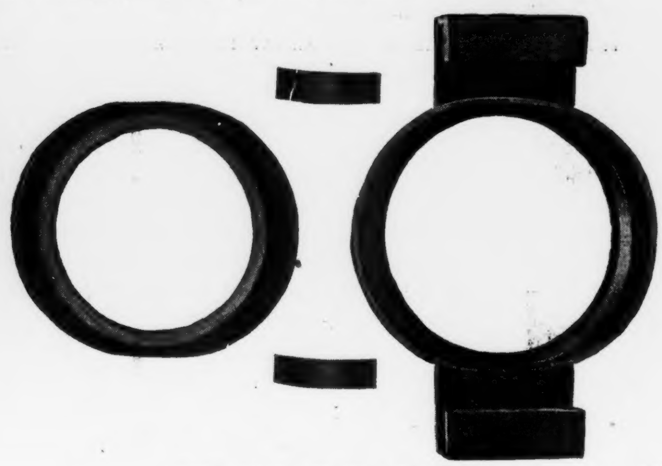
McCORD JOURNAL BOX WITH OUTSIDE DUST GUARD.

A special feature of the McCord journal box has been the construction which has made the lid tight, preventing the entrance of dust. The usual form of dust guards, however, was depended upon to keep dust from entering at the other end, and both ends must be dust tight in order to meet the journal box problem. The dust guard difficulty has usually been attacked by attempts to make tight joints upon rough and uneven surfaces. The new McCord box has no dust guard slot. This portion of the standard box has been cut off and the back end of the box carries a boss surrounding the axle and terminating in a ground surface. The dust guard is in the form of a cast iron ring turned to fit the dust guard portion of the axle. The box has lugs upon its inner face and these serve to hold in place a malleable iron shell which encloses the dust guard ring and this shell is urged toward the box lugs by springs enclosed in cavities in the outer faces of the lugs, as indicated in the engraving. The dust guard ring is ground on its inner face to make a joint with the boss on the box. The springs hold the shell against the dust guard ring and are sufficiently strong to take the weight of the ring off the axle and the ring is free to move with the axle. The sectional drawing shows the form of the joint between the dust guard and the box, and also that between the dust guard and the shell. If desired the dust guard ring may be made in segments, which will be always urged toward the center by the shell, so as to take up wear. This, however, will probably not be necessary, as a wear of less than 1-64-in. has been found in a mileage of over 100,000 miles on a locomotive tender. This leads to the conclusion that without sectional rings the guard will outlast the usual life of a freight car.

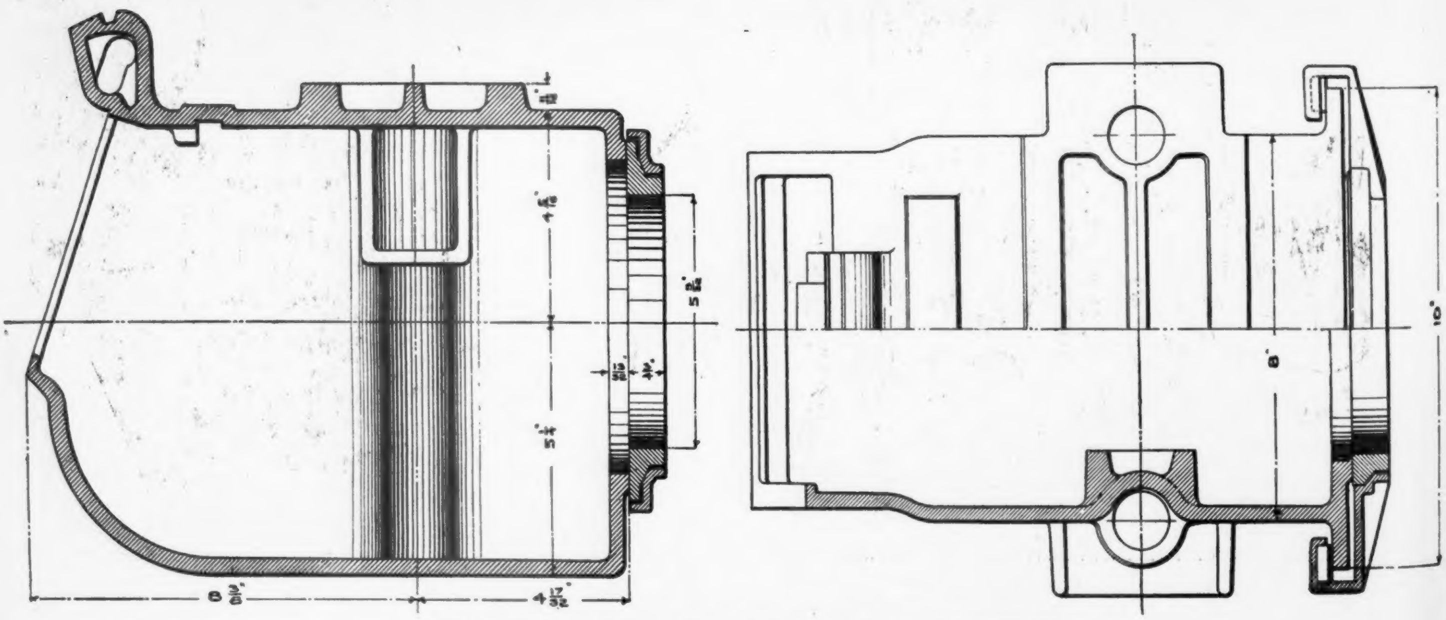
This guard has four parts. It is made entirely of metal and will not be injured by a hot box. It is claimed that it will raise the oil level at the back of the box to the center of the journal, that there is no possible way for dirt to obstruct it or interfere with its effectiveness. This construction allows 3-8 in. more clearance between the guard and the wheel than is to be had with the usual construction of journal boxes with dust guard slots. This new box has already been specified upon about 5,000 cars, and it is stated that because of the saving of weight, its cost is but little more than the ordinary box with wooden dust guards. Further information may be had from McCord & Company, Old Colony Building, Chicago, Ill.



MCCORD JOURNAL BOX WITH OUTSIDE DUST GUARD.



DUST GUARD RINGS AND SHELL.



SECTIONS THROUGH NEW MCCORD JOURNAL BOX AND DUST GUARD.

Compressed Air, A Treatise on the Theory and Practice of Pneumatic Power Transmission. By W. C. Popplewill. Published by the Scientific Publishing Company, 53 New Bailey Street, Manchester, England, 1903. Price 7s. 6d.

This book is not exhaustive and not entirely original. It presents the principles of compressed air transmission with a chapter on calculations, one on tests of compressed air machinery, while the major part of the space is occupied by descriptions of air compressors, air motors and tools and transmission pipings. An unusually large number of compressors are described, including several operated by the hydraulic principle. The author has drawn a balance between theory and practice and gives some of each. This book ought properly to be one of several volumes on the subject. It is not sufficiently complete for present needs in the literature of compressed air. Perhaps the author will be encouraged to keep on and write the encyclopedia, which is needed on this subject.

A LARGE INSTALLATION OF WATER-SOFTENING APPARATUS FOR THE ROCK ISLAND.

FOR THE LOCOMOTIVE SUPPLY OF AN ENTIRE DIVISION.

The Chicago, Rock Island & Pacific Railway are preparing to equip an entire division with a system of water purifiers and softeners for the locomotive water supply. In common with most of the other roads in the West, this System has experienced a great deal of trouble from bad water, and now proposes to give water-softening a fair and impartial trial by equipping their entire Kansas division, with seventeen installations, located at the locomotive water supply stations. The waters throughout their Kansas division have always been a source of trouble and expense, and that division was naturally selected as the most favorable for this installation. As was recently stated in this journal, the only way to give water purification a fair trial is to equip an entire division, so that certain engines may always use the treated water and not mix the good with the bad, and it is important that the necessity of this should be appreciated. In several cases engines which, with bad water, required retubing as often as every six months, are now using only treated water, and the expectation of more than doubling the life of the flues is warranted. This is an excellent test. The best comparison can only be made when entire divisions are thus equipped, which, although expensive, will unquestionably pay.

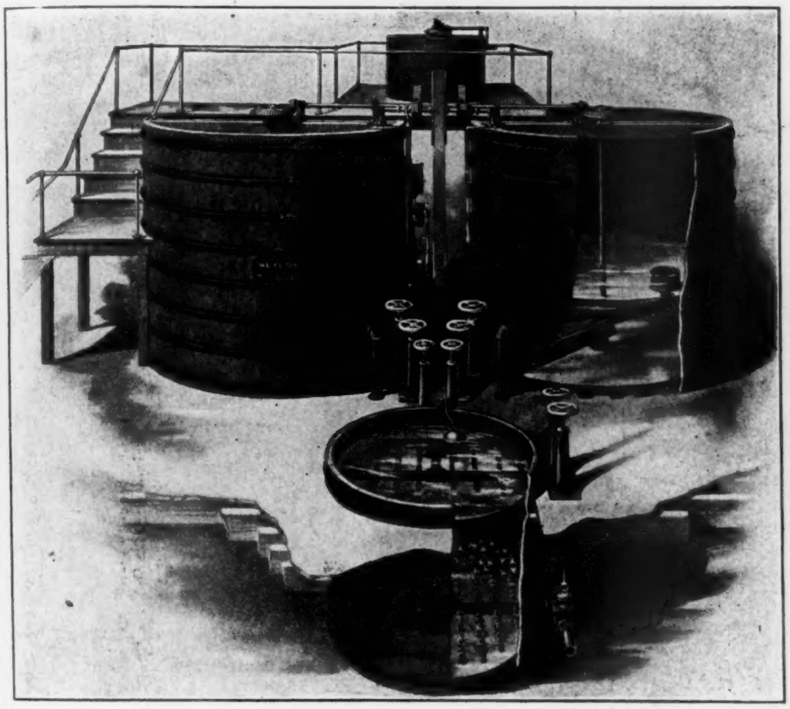


FIG. 1.—VIEW OF APPARATUS USED IN THE WE-FU-GO SYSTEM OF WATER SOFTENING AND PURIFICATION, SHOWING DIAGRAMMATICALLY THE MODE OF OPERATION.

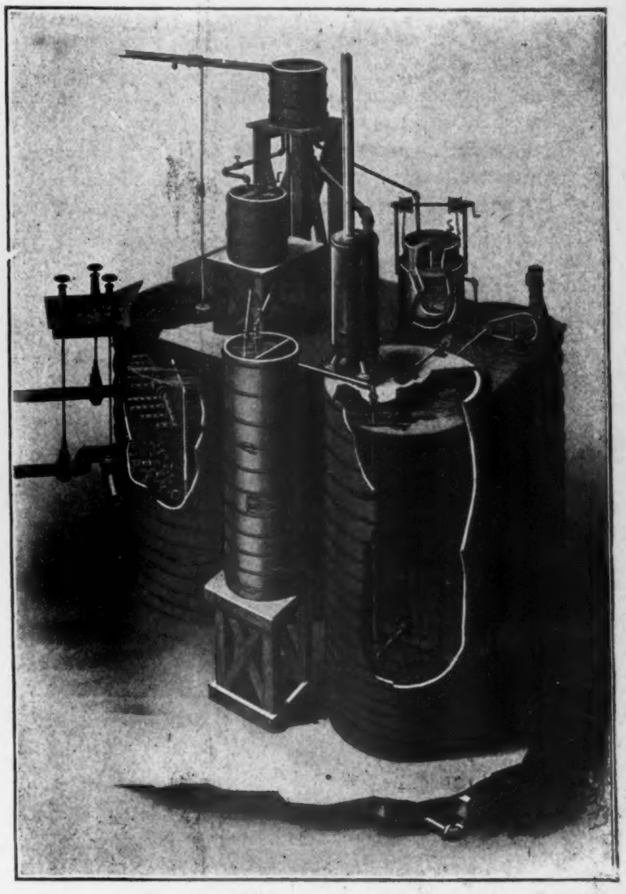


FIG. 2.—DIAGRAMMATIC VIEW OF THE WE-FU-GO CONTINUOUS SYSTEM OF WATER SOFTENING AND PURIFICATION.

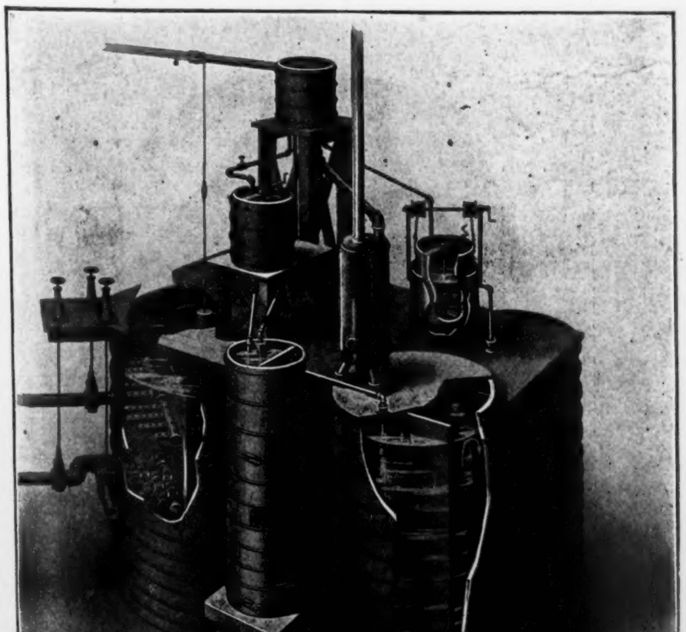


FIG. 3.—DIAGRAMMATIC VIEW OF APPARATUS USED IN THE SCAIFE AUTOMATIC SYSTEM OF WATER PURIFICATION.

After a thorough investigation of the various systems of water-purifying on the market, the contract for this equipment was let to William B. Scaife & Sons Co., of Pittsburgh, Pa., the manufacturers of the Scaife and We-Fu-Go softening and purifying systems. Both of these systems are now well known and perfected; plants operating under them, in every part of the country, and for every purpose, are daily purifying over 300,000,000 gallons of water. Some of these plants have been in operation for eight and nine years. A brief description of these systems may be of interest:

The We-Fu-Go system (which was formerly manufactured by the We-Fu-Go Company, of Cincinnati, Ohio, until purchased by William B. Scaife & Sons Co.) is shown in the first cut (Fig. 1). It consists essentially of two settling tanks and a small chemical tank, with, first, the necessary pipe connections to admit the raw water to either one of the settling tanks or to the chemical tank; second, the pipe connections necessary to draw off the purified water from either settling tank at the top, by means of a hinged floating take-off pipe; and, third,

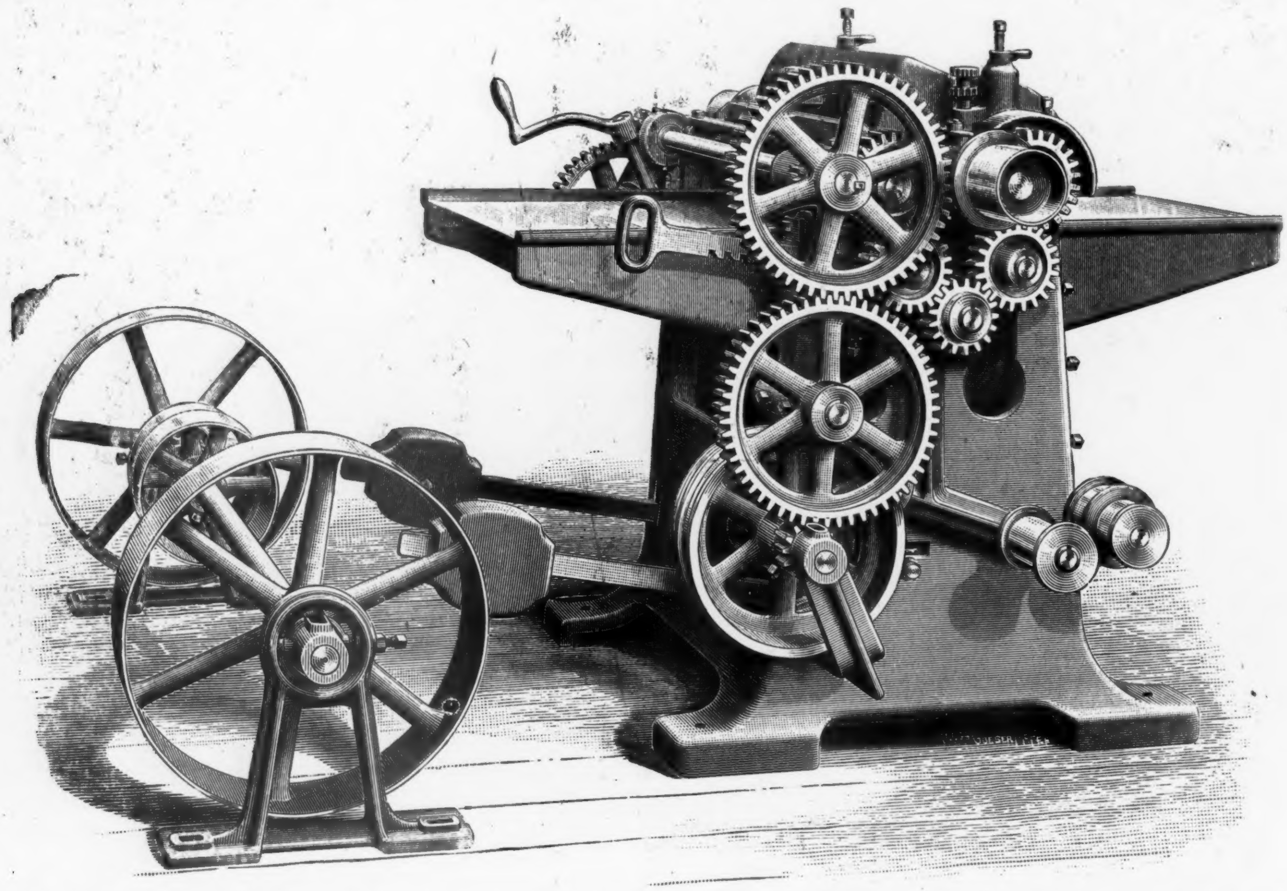
waste or wash pipes through which to get rid of the sludge collected in the bottom of either settling tank. Mixing of the chemicals and the raw water is accomplished by mechanical stirring devices which are driven by a small engine; the stirring devices are designed to give the water a rolling motion, which materially assists chemical action and hastens precipitation. The treated water, after being drawn off through the floating take-off pipe, is conducted to a gravity filter, which removes any matter carried in suspension, thus causing the water to leave the plant soft and clear.

The operation of this system is as follows, in detail: While filling the left-hand settling tank with raw water, the exact amount required of the first chemical reagent is weighed and put into the small elevated chemical tank, dissolved, and then washed into the settling tank; when this settling tank is full the second chemical is added and the water stirred for a few minutes longer. It is then allowed to settle several hours, so as to permit the greater portion of the precipitates and suspended matter which the water will then contain, to deposit. After this the water is drawn off through the filter below, and is ready for use. It can be drawn off as desired, using the settling tanks as storage tanks. This system has the advantage that, inasmuch as definite quantities of water are treated each time, it can always be correctly treated, no matter how variable the water or amount used may be.

Another system controlled by the Scaife Company is the We-Fu-Go continuous system, which is illustrated by Fig. 2. This system involves a continuous process, and consists essentially of three tanks—a reaction tank for the lime, a reaction tank for the soda, and a large settling tank equipped with a regular gravity filter. The chemicals are introduced in proportion to the flow of water through the tanks, and thorough mixing is brought about by the use of a small engine which drives mechanical stirring devices, as shown in the illustration. The saturating tank, for making the saturated solution of lime, is said to be an especially efficient device; in a series of tests the quantity of lime water introduced into the system varied from 1 gal. to 100 gals. per minute, but the solution did not vary 4-10 of a grain to the gallon. This shows the efficiency of this portion of the apparatus, as the results obtained from a continuous system are almost entirely dependent on the successful making of a continuous supply of uniformly-saturated lime water. This system is so designed that the water has from four to six hours to pass through the tanks, so as to allow ample time for the chemical action and settling. A heater is shown in the cut, but it is only employed when the water is of such a nature as to make it desirable to slightly heat it, or to prevent its freezing in cold weather.

The third system of this company is the Scaife automatic system of water purification. This system is especially adaptable to locations so isolated that little attention can be given it, and where steam for driving a small engine is not available. One of these plants is illustrated in Fig. 3. The mixing and precipitation is brought about by the water passing over and under vertical partitions in the lime reaction and soda reaction tanks, as shown. This system is also provided with a mechanical gravity filter in the settling tank, in the same manner as the system described above. The same lime-saturating and soda-introducing devices are employed in this system as in the We-Fu-Go continuous system.

These systems have been in use, mainly in stationary plants, for a number of years, with great success. Seventeen of these plants will be installed for the Rock Island at the various water stations on the Kansas division. The conditions were carefully gone into in considering these installations, and the system best adapted to meet the conditions at each particular point was adopted. Thus, with the variety of the systems manufactured by William B. Scaife & Sons Co., every possible condition will be met, each system being designed especially for each particular water, and for the particular location and requirements at each point—these are features which will be readily appreciated by all railroad men.



THE NEW DESIGN OF 24-IN. SURFACE PLANER, WITH GEAR-DRIVEN UPPER AND LOWER FEED ROLLS.—GREAVES, KLUSMAN & CO.

A speed of a mile in 39 seconds is reported in an automobile contest in Ormond, Fla., on a rate of 92.3 miles per hour. This was done by Mr. W. H. Vanderbilt, Jr., with a 90-h.p. Mercedes machine. Mr. Vanderbilt believes that he can make much faster time with the same machine.

A HEAVY NEW DESIGN OF SURFACE PLANING MACHINE.

GREAVES, KLUSMAN & CO.

In the accompanying engraving is shown an important new design of 24-in. surface planer that has recently been developed and placed upon the market by Greaves, Klusman & Co., Cincinnati, Ohio. It is designed for very heavy service in planing in hard and soft wood, and for smooth planing, strong and fast feeding, and general excellence of workmanship and design, it is claimed to be unexcelled by any machine of this type.

The illustration well shows the general design of this tool. But some of its important points should be referred to. The frame is cast in one piece, wide at the base, and is very heavy, and of great strength. The table or bed is also cast in one piece, planed true, and is dovetailed into the frame, with extra long bearings, as wide apart as the width of frame will allow; this makes the table as steady as if it and the frame were cast in one piece. Any wear can be taken up by means of gibs and set screws. The table is raised and lowered by means of the large crank shown, an indicator on side of the frame showing the exact thickness the machine is set to plane.

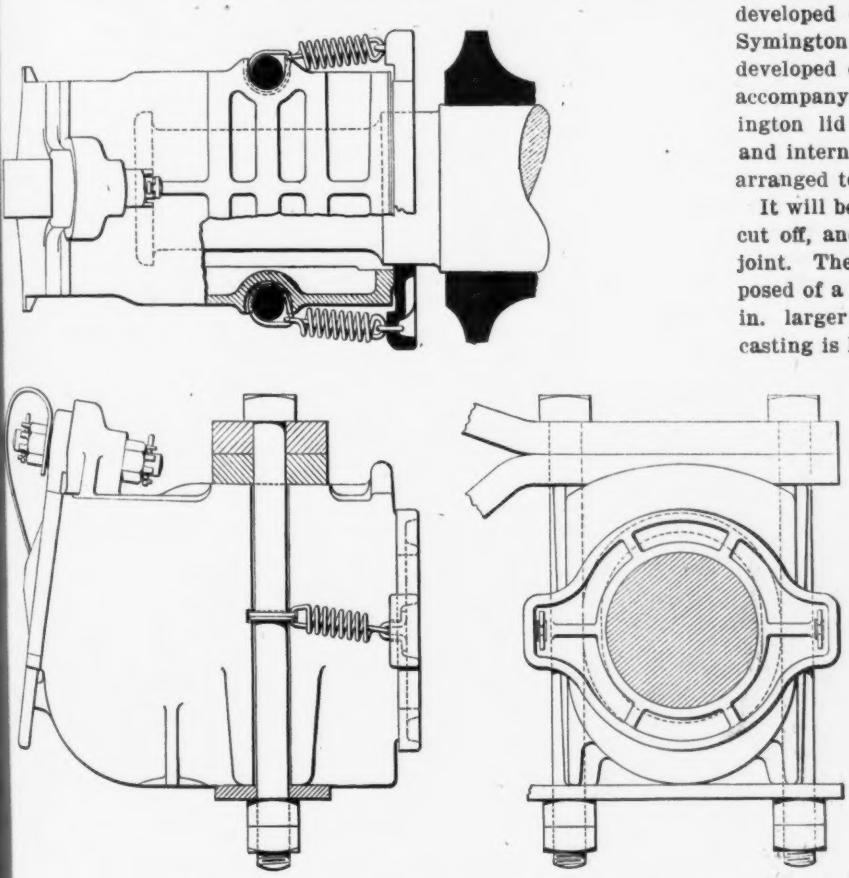
The cylinder is double belted, having a pulley at both ends. It is made of the best forged steel, with 1 13-16-in. journals, which run in self-oiling boxes, 9 ins. long, lined with the best babbitt and provided with improved oil wells and oil cups. The feed consists of 4 large steel rolls, all of which are very powerfully geared. They are driven from the cylinder, there being two changes, fast and slow, controlled by a belt tightener. The lower rolls extend the full width of the bed, having their bearings in planed ways in the frame; these bearings or boxes are milled to fit the frame.

Both pressure bars work very close to the knives, and are adjustable to the timber independently of each other and the feed rolls, thus insuring steadiness, even when planing very short and thin stuff, and the most perfect work with either hard or soft lumber. The pressure bars are self-adjusting, always regulating themselves to the various sizes of thick and thin lumber being planed.

This machine will plane stock from 1/8 in. and less, in thickness, up to 8 ins., and any width up to 24¼ ins. It is to be noted that it can be belted in any direction. It is claimed that this planer will compare favorably, in quantity and quality of output, with any of the larger and more elaborate machines of this class.

THE SYMINGTON JOURNAL BOX WITH OUTSIDE DUST GUARD.

The Symington M. C. B. dust guard was developed to supply the demand for a dust guard which would go into the slot of the Master Car Builders' box. To meet the demand that has developed on some railroads that have not as yet used the Symington M. C. B. dust guard, the Symington Company has developed during the past year the journal box shown in the accompanying engravings. This box has the well-known Symington lid with machined joint and central spring pressure and internal ribs for supporting the packing. The rear end is arranged to take the new dust guard.



THE SYMINGTON JOURNAL BOX WITH OUTSIDE DUST GUARD.

It will be noted that the entire rear end of the journal box is cut off, and the back of the box is machined off to a perfect joint. The dust guard, consisting of only three parts, is composed of a single grey iron casting, faced off and bored out 1-32 in. larger than the dust guard seat of the axle. This casting is held to the box by means of two helical springs fastened at one end to the dust guard, and at the other end to the journal box bolts with a ring which is inserted in small annular grooves in the box behind the arch bar bolts. It is well known that this form of spring has great durability and efficiency for this kind of service. The Symington company uses only one size spring for all sizes of journal boxes, and agree to replace, free of cost, any spring that fails in two or three years' service. It will be noted that there is no possibility for this dust guard or these springs to become clogged in any way with dirt so as to lose their efficiency. These springs have an upward inclination which relieves the axle entirely of the weight of the dust guard. The dust guard is free to move up or down or to either side, while the projections on the ears of the guard prevent it from turning with the axle. Eighteen months' experience has demonstrated that an enormous mileage can be obtained with a very slight wear on the dust guard, and an imperceptible wear on the axle.

One great advantage claimed for this construction over others of this type is that the dust guard is first put on the axle and then on the box. The side springs are then pulled out and the arch bar bolts dropped through the clevices on the ends of the springs. This dust guard provides from 3/8 to ½ inch more clearance between the hub of the wheel and the face of the box than the Master Car Builders' design, which is very desirable.

The Symington company are so convinced of the merits and durability of this dust guard that they guarantee it for the life of the wheel. It is stated that the saving in the weight of the box proper permits this new design to be sold complete, with dust guard, at the same cost as the regular Symington M. C. B. box, with any patented dust guard. New dust guard castings can always be secured for the cost of any special dust guard. Further information may be obtained from the T. H. Symington Company, No. 706 Paul street, Baltimore, Md.

A recent study of coupler failures on a large railroad, covering 16,000 breakages of couplers, revealed the fact that 32 per cent of the total number were due to broken knuckle pins. While this is due to some extent to poor fitting of the pins in the couplers and kunckles, the facts which were ascertained point to the necessity for using better material for these pins.

BOOKS AND PAMPHLETS.

A Treatise on Friction and Lost Work in Machinery and Mill Work. By Robert H. Thurston, M. A., LL. D., Dr. Eng'g. Past President of American Society of Mechanical Engineers and late Director of Sibley College, Cornell University. 8vo. 430 pages, 77 figures, illustrated. Seventh edition. Published by John Wiley & Sons, 43 East Nineteenth St., New York. Price, $3.

This work of Professor Thurston's is well known for the thoroughness with which it treats this important subject, and its popularity is attested by this seventh revision and enlargement of the work. This seventh edition brings the contents well up to date and adds a considerable amount of new matter, which appears in the form of a summary at the end of the volume. Many new problems in friction and lubrication, which have arisen with the high speeds of electric motors and steam turbines, receive proper attention in this edition, as new and extensive studies of the subject have been completed. Most of the important later researches on the subject of lubrication and friction have been abstracted and are here published. Much new information has also become available in relation to the classes of lubricants, old and new, which have been found suitable to special uses, and the adaptation of its special lubricant to every rubbing part, its load and its velocity of rubbing being considered, has come to be an acknowledged essential art, and great progress has been made in its development; much is added along this line. The work is the most complete treatise on the theory of friction to be found in the English language, and the important work which Professor Thurston has done in this volume is to show that it is the sum of the cost of wasted power and of lubrication, not simply the lubricant, that has to be minimized, and this is the real problem of the engineer in dealing with this branch of his work.

Rotary Planers.—Catalogue No. 37 has recently been issued by the Newton Machine Tool Works, Philadelphia, Pa., descriptive of their extensive lines of Rotary Planing Machinery. Various types of their rotary planers are illustrated and described, including their portable rotary planers, vertical rotary planers, duplex rotary planers and planers mounted on circular bases. Illustrations are also presented of other machine tools of the large line built by this company.

Gorton Disc Grinders.—An interesting catalogue has recently been received from the Diamond Machine Company, Providence, R. I., descriptive of the large line of Gorton universal and plain Disc Grinding Machines, which are now being manufactured by them. The latest refinements in disc grinding are referred to in this book. Universal disc grinders, with single and double-head arrangements, are illustrated in detail; also a large line of motor-driven grinders are shown, adapted to all classes of service. An interesting tool is that shown for use in grinding the ends of tubes, rods, shafting, etc. The vertical floor disc grinders, which are also made by this company are very important for a wide range of grinding service. This is an invaluable catalogue and should be in the hands of all interested in modern machine shop practice.

Electrical Machinery.—A most beautiful catalogue has recently been issued, descriptive of the large line of dynamo-electrical machinery, which is built by the Triumph Electric Company, Cincinnati, Ohio. In addition to illustrating their standard types of multipolar generators, for belt-driven and direct-connected work, and their steel motors for all classes of service, a large number of illustrations are presented, showing important installations which they have made in various industrial plants and elsewhere. This company has made a specialty of direct-connected generators for marine work, as well as for stationary work. In the line of motor-driving for direct application to machinery this company has had a wide and extensive experience. Their enclosed type of motor is especially adapted for use under the trying conditions usually met in machine-tool driving. A large number of illustrations are presented to show actually applications that have been made of Triumph steel motors to planers, drills, boring-mills, lathes, punches, cranes and other types of machinery. Altogether, this is one of the most complete and comprehensive catalogues of its kind that we have seen. It is beautifully and artistically gotten up and is printed on the finest quality of paper. The engravings are exquisite, and the cover is a work of art. This catalogue should be in the hands of all interested in electrical machinery.

The Jeffrey Manufacturing Company.—Circular No. 77 has just been received, descriptive of The Jeffrey Grab Buckets. These grab buckets are most efficient and economical in operation, as indicated in the pamphlet. They will work in ore, run-of-mine coal, broken limestone, gravel and sand; they are also useful in excavating in clay, gravel, and in soft earth of any nature, and when teeth are added to the scoops, this device may be made to answer the purpose of a steam shovel in many kinds of work. Reference is also made in this pamphlet to the large number of catalogues, which are issued by The Jeffrey Manufacturing Company, Columbus, Ohio, descriptive of their many other lines of automatic machinery; any of these catalogues may be had upon request.

The second edition of catalogue No. 115, the general condensed catalogue of the B. F. Sturtevant Company, Boston, Mass., is now ready for distribution. This catalogue describes and illustrates new apparatus manufactured by this enterprising company, among which are a new type of hand-blower; several new types and sizes of forges; new sizes of vertical single and double engines; a new type of enclosed vertical compound engines; new type of semi-enclosed bi-polar and four-pole motors; new sizes of generating sets with vertical compound engines; factory equipments, such as bench-legs, pattern storage shelf brackets, electric hoists, cast iron sinks, trench cover-plates, etc.; industrial railway equipments, such as cars, truck ladles, turn-tables, T-rails, etc. It also contains a description of the various Sturtevant systems, such as heating and ventilating, special ventilating, drying, conveying and mechanical draft systems.

EQUIPMENT AND MANUFACTURING NOTES.

The Jeffrey Manufacturing Company, of Columbus, Ohio, through its connection with the Ohio Malleable Iron Company, located in the same city, are now in the field soliciting orders for high-grade malleable castings. They are now prepared to turn out malleable castings in large quantities and the quality is insured.

The T. H. Symington Company and the Baltimore Railway Specialty Company were burnt out in the recent disastrous conflagration in Baltimore. They ask the indulgence of their railroad friends and their characteristic energy may be counted upon to place them in the near future in position to meet all requirements. The foundries were not involved, and they are prepared to take care of all business. The new office is at 706 Paul street, Baltimore, Md.

Contradicting the suggestion of a slacking of business activities comes the report from the Imperial Pneumatic Tool Department of the Rand Drill Company telling of the large increase of sales since the first of the year. That the worth of their products is universally appreciated is proven by the orders received for piston air drills, wood boring machines and hammers, and the installation of a number of complete pneumatic tool plants in the railroad shops, ship yards, boiler works, foundries and bridge and iron works, both in this and foreign countries.

Mr. P. H. Wilhelm, formerly representing the New York Car Coupler Company, the Washburn Car Coupler Company, the Buckeye Malleable Iron and Coupler Company, the Railroad Supply Company, of Chicago, with headquarters at Atlanta, Ga., has accepted a position as railroad representative of the American Steam Gauge and Valve Manufacturing Company, Boston, Mass., with branch offices at New York, Chicago, Philadelphia and Atlanta, Ga. Mr. Wilhelm has spent the greater portion of his life in actual railroad service and it will be remembered that, in 1893, he was, on the recommendation of the majority of the railroads, appointed superintendent of transportation at the World's Fair in Chicago. After the close of the exposition, he took up the active business of railroad supplies, which he has followed up to the present time. Mr. Wilhelm has been very prominently mentioned for the position of superintendent of transportation at the St. Louis Exposition, but he prefers to remain in the railroad supply business. The American Steam Gauge and Valve Manufacturing Company now have the largest plant in the country devoted to the manufacture of steam and other gauges, safety valves, steam engine indicators, whistles and steam supplies in general, and, being the oldest house in this country in their particular line, Mr. Wilhelm will certainly be able to keep up his reputation of representing one of the best concerns.